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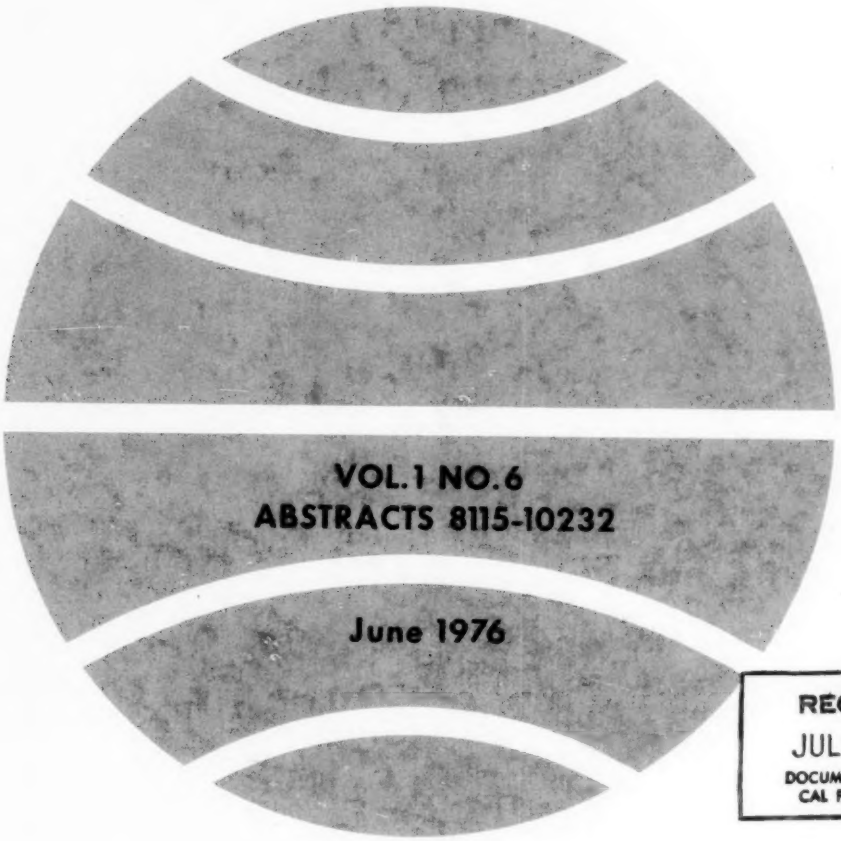

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Volume 1, Number 6, June 1976

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    size of coal particles), 75:702
COAL GASIFICATION
    See also COED PROCESS
             SYNTHANE PROCESS
COAL GASIFICATION/BI-GAS PROCESS
  Environmental aspects of the BI-GAS process
    (Reactive components in coal are completely
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    75:00744 (NSF-RA/N--74-144)
TEXTRON, INC., SYLMAR, CALIF. (USA). SPECTROLAB DIV.
  Terrestrial photovoltaic power systems with sunlight
    concentration. Quarterly porgress report, July 1,
    1974--September 30, 1974, 75:00737 (NSF-RA/N--74-129)
THERMO ELECTRON CORP., WALTHAM, MASS. (USA)
  Advanced thermionic technology, FY1975. Progress report
    number 4, October 1974, 75:00821 (TE--4190-57-75)
TYCO LABS., INC., WALTHAM, MASS. (USA)
  Continuous silicon solar cells. Third quarter progress
    report, July 1, 1974--September 30, 1974, 75:00742
    (NSF-RA/N--74-139)
  Scale-up of program on continuous silicon solar cells.
    Semiannual progress report, May 1, 1974--June 30, 1974,
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Volume 1, Number 6, June 1976

ERDA ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 8795, 8818, 8821, 8825

8115 **Coal conversion and utilization R and D in ERDA.** Zahradnik, R.L. pp vp of In Second annual symposium on coal gasification, liquefaction, and utilization: best prospects for commercialization. Pittsburgh; Univ. of Pittsburgh (1975).

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

See CONF-750868—.

After a brief review of the history of the uses of coal and its production, the organization of US ERDA and some of its predecessors is discussed. Various aspects of coal conversion and utilization are described. Major projects are shown in tabular form for coal liquefaction, high Btu gasification program, low Btu gasification, advanced power systems, and direct combustion. (EJH)

PROCESSING

REFER ALSO TO CITATION(S) 8776, 8824, 9183

8116 (ERDA—1547(Draft)) **Synthetic fuels commercialization program. IV. Draft environmental impact statement.** (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1975. 985p. USERDA, Washington, DC.

A Draft Environmental Impact Statement has been prepared for a Synthetic Fuels program to provide the equivalent of 350,000 barrels of oil per day initially, and possibly 1,000,000 barrels per day by 1985. A variety of incentives is recommended to facilitate the accomplishment of the program. Various coal gasification and liquefaction processes, oil shale processes and a solid waste pyrolysis process are described briefly. Several coal and oil shale regions with sufficient reserves are described and a tentative choice of plant type is made for each. Environmental effects are treated: air pollution (sulfur oxides, nitrogen oxides, particulates, hydrocarbons, carbon monoxide, aldehydes, and probably some possibly carcinogenic polycyclic aromatic hydrocarbons); water quality degradation (including considerable water requirements, aquifer and stream disruption, erosion, sedimentation, acid mine drainage, various pollutants); terrain changes due to mining, construction, solid waste disposal (spoil banks); effects on flora, fauna, agriculture; and effects on municipalities. Several alternative courses of action are treated briefly. (LTN)

8117 (ORNL/TM—5246) **Coal Technology Program. Progress report for December 1975.** (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 19p. Dep. NTIS $5.00.

This report, the seventeenth of a series, is a compendium of monthly progress reports in support of the increased utilization of coal as a source of clean energy. The projects reported include those for hydrocarbonization, solid-liquid separations, chemical research and development, engineering evaluations of nuclear process heat for coal conversion, engineering evaluations of the hydrocarbonization and synthoil processes, and coal-fueled MIUS. Two more runs were completed with the bench-scale hydrocarbonization research system using nitrogen at 20 atm with the preheater at 1400°F and the reactor at 1250°F. Some difficulty was encountered with the coal feeder and corrective modifications are underway. Revisions and additions were made to the flowsheet for a plant using direct steam gasification of coal, which is thermally driven by a 3000-MW(t) VHTR. In the engineering evaluations work for the synthoil process, flow diagrams for four units were finalized. A preliminary facility site plan was developed. Conceptual design of the solids-liquid separation plant specifying centrifugation followed by filtration of the thickened underflow was completed. In the MIUS program, a $^1/_{12}$ scale model of the latest layout is being constructed. (auth)

CARBONIZATION

REFER ALSO TO CITATION(S) 8201

8118 (ERDA—114-75/1, pp 31-34) **Clean Coke process.** (United States Steel Corp., Pittsburgh). 1975.

In Coal liquefaction. Quarterly report, January—March 1975.

During this quarter, both process development unit and laboratory research concentrated on development of the carbonizaton aspect of the process. Preliminary instrumentation specifications and utility requirements for the carbonization process development unit were begun. Four carbonization runs were conducted in the process development unit. The bench-scale carbonizer deentrainment section was modified to provide more heat and to permit more fines to return to the fluidized-bed portion of the carbonizer, and the upper stage was modified to operate at a higher temperature. Incoloy Alloy 800, the construction material of the process development unit, was tested for the effect of high temperatures. Work was also conducted on coke preparation, hydrogenation, and liquid processing. (auth)

8119 (FE—1220-04) **Clean coke process: process development studies. Report for third quarter, 1975.** (United States Steel Corp., Pittsburgh, Pa.). Nov 1975. Contract E(49-18)-1220. 19p. Dep. NTIS $3.50.

The coal-preparation equipment was used to prepare 6300 lb of 20- by 65-mesh coal as feed for the carbonization PDU. Maintenance work on the carbonization PDU included installation of the new heater-element subassembly, an external cyclone, the rebuilt rotary feed valves, and a final filter on the wash-oil blowdown line. After a satisfactory 4-day shakedown run, a successful 10-day high-temperature carbonization run was completed. In the run, 2876 lb of semichar was carbonized to produce 2238 lb of char containing 0.61 to 0.70% S. Total PDU operating time is now 1421 hr, including 560 hr at 1300°F or higher. A new topped tar pump was installed in the binder-preparation PDU. Preparations were made for installing a tube-type recycle heater. Some stable operation of the vapor stripper of the hydrogeneration PDU was achieved. Distillation results for stripper products indicate that a separation of light and heavy components is occurring in the stripper. A heated enclosure to prevent heat losses has been installed over the 2-ft pelletizing disc of the coke-preparation PDU, and a method has been devised for cleaning the binder sprays. (auth)

8120 (UCRL-Trans—10987) **Determination of coke reactivity.** Roubicek, V.; Kaloc, M. Translated from *Sb. Ved. Pr. Vys. Sk. Banske Ostrave, Rada Hutn.;* **19**: No. 1, 141-146(1973). 9p. Dep. NTIS $3.50.

The reactivity of several cokes was expressed as the velocity constant, K/sub m/, of the reaction $CO_2 + C = 2CO$. The apparatus is described and the procedure specified. The method gave reproducible results when applied to 7 coke samples. Five of these samples were very similar. There remain some qualifications with respect to possible effects of different particle size. The test also

involved precise flow and temperature control which were not easy to meet. (LTN)

8121 Continuous carbonization and gasification of particulate coal with double recirculation of fluidized particulate heat carrier. Kunii, D. US Patent 3,912,465. 14 Oct 1975. Priority date 18 Aug 1973, Japan. 10p.

An apparatus and continuous process for the carbonization and gasification of particulate coal with double recirculation of fluidized particulate heat carrier is disclosed wherein the carbonization and gasification are separately carried out. The process comprises the steps of fluidizing particulate heat carrier with steam to form a first fluidized bed, passing the particulate heat carrier through the first bed in a densely fluidized state from the bottom upwardly to the top of the first bed, and introducing particulate coal into the first bed thereby contacting said coal with the heat carrier to effect carbonization of the coal. The resultant gas and oil vapor are withdrawn from the first bed, and a mixture of the particulate heat carrier and particulate coke produced by the carbonization of the coal is passed from the top of the first bed to the bottom of a second fluidized bed, and the particulate mixture is combined at the bottom of the second fluidized bed with particulate heat carrier coming from a third fluidized bed at a higher temperature. The gasified product is withdrawn from the second bed and a portion of the particulate heat carrier is passed from the top of the second bed to the bottom of a third fluidized bed. The particulate heat carrier together with the accompanying ungasified particulate coke is passed through the third fluidized bed in a densely fluidized state from the bottom upward to the top of the third bed, and a hot combustion gas containing air or oxygen is introduced into the third bed therebyburning the ungasified particulate coke and heating the particulate heat carrier. (auth)

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 8161, 8172, 8185, 8186, 8202, 8211, 8225

8122 (NTIS/PS—75/593) Coal beneficiation. A bibliography with abstracts. Search period covered: 1964—June 1975. Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Jul 1975. 96p. NTIS $25.00.

This bibliography contains 71 abstracts dealing primarily with separation of pyrite from coal and washability studies. Included are abstracts on washing equipment and coal cleaning plants. A few abstracts pertain to preparation characteristics of coal from various mines. (auth)

8123 Chemical comminution for cleaning bituminous coal. Howard, P. (Syracuse Univ. Research Corp., NY); Hanchett, A.; Aldrich, R.G. pp 733-750 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Significant reserves of bituminous coal in the Interior Basin and Appalachian Region are available for use as a 1% sulfur fuel or feed stock when cleaned by physical methods. Since 1971, Syracuse University Research Corporation has been conducting an exploratory study on a method for improving coal preparation processes by the removal of pyritic sulfur and ash from bituminous coal. Preliminary results indicate that the method which is based on breakage or comminution induced by chemical treatment has definite promise. Data are presented that show how major grades of bituminous coal respond favorably to the treatment. Although primarily directed to improving coal for fuel and metallurgical uses, the process is visualized to have application for feed-stock to future coal conversion processes and for other modified combustion and flue gas cleaning developments. In addition, the fracturizing reaction with ammonia and the other agents may have application in the mining of coal.

8124 Removal of sulfur from carbonaceous fuels. Schroeder, W.C. US Patent 3,909,212. 30 Sep 1975. Filed date 29 Jun 1973. 12p.

The sulfur content of solid carbonaceous fuels, such as coal or lignite, is reduced by reacting a portion of the fuel with oxygen and steam without complete carbonization of the fuel, so as to generate nascent hydrogen at the surface and within the fuel particles for reaction with the sulfur in the fuel to form hydrogen sulfide. The resulting sulfur containing gases are removed and a low sulfur, solid fuel is recovered which can be burned, without further treatment or use of special devices, in furnaces or other combustion equipment with production of stack gases which meet pollution regulations regarding sulfur emissions. Alternatively, the low sulfur solid fuel may be gasified to produce low sulfur fuel gases or gases for the manufacture of industrial chemicals. (auth)

8125 Desulfurization process start-up method. O'Hara, M.J. (to Universal Oil Products Co.). US Patent 3,909,396. 30 Sep 1975. Filed date 20 Oct 1972. 6p.

Adsorbed water exhibits a deactivating effect upon catalytic composites utilized for the hydrogenative desulfurization of hydrocarbonaceous charge stocks. Such composites, generally comprising an alumina-silica carrier material are dried, prior to contacting the charge stock, via a method which does not of itself induce deleterious effects respecting either catalyst activity, or stability. Drying is effected in a non-reducing atmosphere at static conditions. (auth)

8126 Desulfurization of coal. Sanders, R.N. (to Ethyl Corp.). US Patent 3,909,213. 30 Sep 1975. Filed date 17 Dec 1973. 8p.

A process is disclosed for desulfurization of coal which comprises digesting, in a digestion zone, coal and a Group IA or IIA metal oxide or mixtures thereof in the presence of a fused metal chloride salt medium which is capable of dissolving sulfur-containing organic compounds present in the coal and which has a melting point below the digestion temperature; passing anhydrous hydrogen chloride into the digestion zone and removing from the digestion zone desulfurized coal. Subsequent refining of the desulfurized coal is also disclosed. (auth)

8127 Absorption system for separate recovery of carbon dioxide and hydrogen sulfide impurities. Jakob, F. (to Linde Aktiengesellschaft). US Patent 3,910,777. 7 Oct 1975. Priority date 20 Dec 1972, German, Federal Republic of (F.R. Germany). 10p.

In a gas purification process gaseous impurities comprising carbon dioxide and hydrogen sulfide are scrubbed from gases with an organic polar solvent scrubbing agent. The process is conducted under superatmospheric pressure, and at a low temperature. The resultant loaded scrubbing agent is expanded to liberate a portion of the components dissolved therein, and after the expansion of the loaded solvent, the resultant expanded solvent is stripped with a stripping gas to remove the hydrogen sulfide and the resultant loaded stripping gas containing the hydrogen sulfide is scrubbed with hot-regenerated scrubbing agent to remove the hydrogen sulfide therefrom. (auth)

8128 Recovery of carbon from synthesis gas. Richter, G.N.; Slater, W.L.; Child, E.T.; Ahlborn, J.C. (to Texaco Inc.). US Patent 3,917,569. 4 Nov 1975. Filed date 28 Jun 1974. 6p.

Carbon is recovered from synthesis gas by scrubbing with water and using a two-stage hydrocarbon addition technique to separate the carbon from the water-carbon slurry. (auth)

8129 Removal of pyritic sulfur from coal using solutions containing ferric ions. Meyers, R.A. (to TRW Inc.). US Patent 3,917,465. 4 Nov 1975. Filed date 30 Oct 1973. 6p.

Finely divided coal or solid coal derivatives containing pyrite are reacted with a ferric ion solution; $FeCl_3$ is particularly suitable. The ferric ion is reduced to ferrous ion and free sulfur is formed. The solution is then filtered from the coal which is then washed and heat dried under low pressure. Most of the free sulfur is volatilized from the coal due to the heat drying; additional free sulfur can be removed by additional washing and heat drying and/or solvent extraction techniques. At least 60 percent of the pyrite sulfur and pyrite iron is removed using the process of this invention. If desired, the ferrous chloride can be regenerated; this permits iron oxide to be recovered as a byproduct. (auth)

8130 Chemical comminution of coal and removal of ash including sulfur in inorganic form therefrom. Aldrich, R.G. (to Syracuse University Research Corp.). US Patent 3,918,761. 11 Nov 1975. Filed date 30 Sep 1974. 10p.

Treatment of coal with ammonia, which contains water, whether the coal is in a sub-surface stratum or in large lumps as mined by standard means weakens interlayer forces at natural interfaces present in the coal. The extent to which the interlayer forces may be reduced by this treatment is such that the coal may be reduced to fragments without application of mechanical force. Further, inorganic compounds present in the coal are unaffected by said treatment, as a result of which inorganic components, and, particularly, sulfur compounds, may readily be separated from the coal fragments by known means. (auth)

8131 Process and composition for cleaning hot fuel gas. Moore, R.H. (to Secretary of the Interior). US Patent 3,919,390. 11 Nov 1975. Filed date 12 Jul 1974. 8p.

Fuel gases such as those produced by the gasification of coal are cleaned by treatment with a molten salt composition which comprises calcium carbonate dissolved in alkali metal carbonates. The hot fuel gas is contacted with a molten salt mixture which removes both particulates and sulfur compounds from the gas stream. Cleaning of the gas stream and sulfur removal may be accomplished at the temperature at which it emerges from the

gasifier which is usually about 900°C or higher. Spent salt may be regenerated by lowering its temperature to about 500° to 600°C and sparging the molten salt with steam and carbon dioxide.

HYDROGENATION

REFER ALSO TO CITATION(S) 8118, 8169, 8174

8132 (BNL—20754) **Coal conversion to liquid and gaseous hydrocarbons in a cross flow moving bed reactor.** Dang, V.D.; Steinberg, M. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1975. 35p. (CONF-760402—2). Dep. NTIS $3.50.

From 81. national meeting of the American Institute of Chemical Engineers; Kansas City, Missouri, United States of America "USA" (11 Apr 1976).

A study of coal hydrogenation has been performed in a cross flow moving bed reactor. Coal particles move horizontally in packed form in the reactor while hydrogen moves vertically. Temperature distributions of both gas and solid are obtained by solving the energy equations for packed bed. Weight fractions of carbon, and its gas and liquid products, can be obtained using a three-step coal hydrogenation model as a first approximation. The problem is solved numerically for some practical operating conditions of a reactor using a CDC 7600 computer. The effect of several operating parameters on the temperature distribution of the reactor is examined. Increasing the gas residence time will decrease the temperature of both solid and gas phases. Increasing the solid phase residence time will increase the temperature of both phases. Hydrogen partial pressure does not have any effect on the temperature field. An example of the application of the model to a specific set of conditions is presented. High coal conversion yield such as 60 percent or higher can be obtained in the assumed reactor for the following conditions: hydrogen partial pressure of 100 to 400 atm, solid velocity of 30 to 100 cm/sec, particle size of 50 to 60 μm, hydrogen velocity of 25 to 30 cm/sec. (auth)

GASIFICATION

REFER ALSO TO CITATION(S) 8121, 8132, 8204, 8212, 8351, 8822

8133 (ERDA—112-75/1) **Coal demonstration plants. Quarterly report, January—March 1975.** White, P.C.; Zahradnik, R.L.; Cochran, N.P. (Energy Research and Development Administration, Washington, D.C. (USA). Office of Fossil Energy). 1975. 25p. Dep. NTIS $3.50.

This report consists of three sections in addition to an executive summary and a glossary. Each section was abstracted and indexed. (EJH)

8134 (ERDA—112-75/1, pp 5-11) **Clean boiler fuel demonstration plant.** (Coalcon Co., New York). 1975.

In Coal demonstration plants.

During the quarter, Coalcon's primary effort was directed toward completing the preliminary commercial plant concept design, with secondary priorities assigned to the demonstration plant design, and to producing specifications suitable for the procurement of long-lead-time items. Coalcon evaluated and selected alternative subsystems for use in the low-pressure hydrocarbonization process applicable to both the demonstration and commercial plants. The effort included development of subsystem mass and heat balances, preparation of process flow diagram sketches, analysis of process streams, and determination of process parameters. Coalcon determined that, for the coal heating and pressurization subsystem, cyclone-stage heating was superior to the proposed pipe-coil heating system. Coalcon also determined that the Rectisol system for acid-gas removal and the cyclone furnace for use in the char burning and steam generation subsystem could not be used without modification; various alternative systems are being investigated. Support activities involved design, construction, or renovation at the various research facilities. Other technical support included updating PROBE data banks, process modeling, data evaluation, and evaluation of alternative equations of state. In addition, major site requirements (with emphasis on coal proximity and cost) were outlined and provided to the governments of Ohio, West Virginia, Indiana, Pennsylvania, Kentucky, and Illinois so that they could begin screening potential sites. Work on determining long-lead-time items to be procured through the U.S. Army Corps of Engineers was initiated. (auth)

8135 (ERDA—112-75/1, pp 13-14) **Engineering and technical support.** (U.S. Army Corps of Engineers, Huntsville, AL). 1975.

In Coal demonstration plants.

The work effort during the quarter involved planning, engineering, and procurement in support of Coalcon's clean boiler fuel demonstration plant. A proposal, by a second proposer, for a clean boiler fuel demonstration plant was evaluated and found nonresponsive. Alternative processing methods being developd by Coalcon were reviewed, potential items to be procured for the plant were identified, and a representative procurement package was prepared. (auth)

8136 (ERDA—112-75/1, pp 15-17) **Technical assistance services.** (Ralph M. Parsons Co., Pasadena, CA). 1975.

In Coal demonstration plants.

During the quarter, Parsons continued the development of conceptual designs for the COED, SRC-based oil-gas, Fischer-Tropsch, and COG plants and for coal mining and preparation facilities. The COED design was nearly completed. Work on technical evaluations included development of proposals for equipment and control apparatus; oil-solid and gas-solid separation, gasification, and pressure recovery turbine systems were of particular concern. Parsons also reviewed and updated a list of construction materials for the oil-gas plant, analyzed corrosion and erosion problems, and reviewed the general approach required for the environmental control program. (auth)

8137 (ERDA—114-75/1) **Coal liquefaction. Quarterly report, January—March 1975.** (Energy Research and Development Administration, Washington, D.C. (USA). Office of Fossil Energy). 1975. 47p. Dep. NTIS $4.00.

This report consists of eight sections in addition to an executive summary and a glossary. Each section was abstracted and indexed separately. (EJH)

8138 (FE—1513-3) **Agglomerating burner gasification process. Design, installation, and operation of a 25-ton-a-day process development unit. Quarterly report, April—June 1975.** Corder, W.C.; Goldberger, W.M. (Battelle Columbus Labs., Ohio (USA)). Sep 1975. Contract E(49-18)1513. 16p. Dep. NTIS $3.50.

This quarterly report covers work done by Battelle's Columbus Laboratories and the subcontractor Chemico on the installation of the Process Development Unit (PDU). Also included in the coverage is work done by Battelle related to PDU systems checkout and operator training. PDU construction completion increased from about 44 percent at the beginning of the quarter to 70 percent at the end of the quarter. A portion of the operating staff was acquired during the period and review of training materials by chief operators was in progress. Battelle field activities included checking P & I's, vendor information, and making line color coding for systems. No systems were mechanically completed for initial start-up operation. (auth)

8139 (FE—2006-1) **Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, June—September 1975.** (Utah Univ., Salt Lake City (USA). Dept. of Mining, Metallurgical and Fuels Engineering). Oct 1975. Contract E(49-18)-2006. 71p. Dep. NTIS $4.50.

Research results related to coal gasification and liquefaction are reported, including fundamental studies on the processes involved and the properties of the coal conversion products. Coal and various coal derived liquids are being extracted with a variety of solvents with the aim of separating, classifying and characterizing the products, using modern instrumental techniques to identify the chemical species. The possibility of converting synthesis gas to methanol or other hydrocarbons with C2 to C5 range is being studied as a means of providing a more convenient shipping alternative. Several studies involved catalysts, including the performance of the reaction involved over a range of conditions (particularly with respect to hydrogenation). The possibility of cracking the heavier oils from the solvent refined coal recycle to provide high grade gasoline was investigated. So far the conversion appears to be low. An experimental apparatus has been constructed for fluid dynamic and heat transfer studies involving gas-solids suspensions in vertical cocurrent flow. Some other work on aspects of coal gasification and liquefaction (involving coal feed variations (particle size, etc.), the catalyst, the residence time, etc.) are reported briefly. (LTN)

8140 (FE—2029-2) **Gasification in pulverized coal flames. Second quarterly progress report, October—December 1975.** Lenzer, R.C.; George, P.E.; Laurendeau, N.M. (Purdue Univ., Lafayette, Ind. (USA). Combustion Lab.). Jan 1976. Contract E(49-18)-2029. 26p. Dep. NTIS $4.00.

This project is concerned with the production of power and synthesis gases from pulverized coal via suspension gasification. A literature review concerning the vortex type gasifier has been completed and a survey concerning the confined jet gasifier is underway. Preliminary design of the vortex gasifier is nearing completion. Test cell and coal handling facilities are in the final

stages of design and coal handling equipment has been received. A mass spectrometer has been ordered and a preliminary survey of high-temperature probes is complete.

8141 (UCID—16845) **Overview of laboratory experiments in support of the Lawrence Livermore Laboratory in situ coal gasification program.** Rozsa, R.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jul 1975. 17p. (CONF-750727—1). Dep. NTIS $4.00.

From Underground coal gasification symposium; Laramie, Wyoming, USA (28 Jul 1975).

This report consists solely of tables, drawings, and graphs for slide presentations. There is no text. (EJH)

8142 (UCRL—50032-75) **LLL in situ coal gasification program. Annual report fiscal year 1975, July 1974—June 1975.** Stephen, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Nov 1975. Contract W-7405-eng-48. 50p. Dep. NTIS $4.00.

During the FY 1975 LLL moved significantly closer to developing and eventually demonstrating the packed-bed process. A successful deep exploratory drilling program, which delineated potential coal sites in southeast Montana and northeast and southwest Wyoming, was conducted. A deep site in the Powder River Basin of Wyoming and a shallow site at Hoe Creek, Wyoming, were chosen for further characterization. Characterization of the shallow site will provide the background for experiments in FY 1976. A number of coal fracture experiments were conducted. Measured permeabilities and fracturing were in good agreement with preshot predictions from one- and two-dimensional stress-strain codes and will serve as process design information for future field fracture experiments. Coal was gasified in 1-ft-long packed-bed reactors with steam and oxygen and gas qualities almost equal to those obtained in the Lurgi process were obtained. The progress of thermal waves was measured and the data compared with modeling calculations. Two feasibility studies involving ERDA, LLL, and industry were conducted during the fiscal year. The objectives of the studies were to evaluate the commercial potential of the LLL packed-bed concept, to examine coal resources available for the concept, and to make recommendations for the R & D programs necessary to demonstrate the process. (EJH)

8143 (UCRL-Trans—10988) **Basic study of underground gasification of coal, using oxygen.** Hokao, Z. Translated from *Nippon Kogyo Kaishi;* 77: No. 881, 970-974(1961). 20p. Dep. NTIS $3.50.

In an earlier paper the first laboratory experiments on the underground gasification of coal using only air were described. This paper reports on the gasification of coal using oxygen. The purpose of the present experiment was to study the outline of the gasification processes that occurred using oxygen. It is concluded that: (1) With oxygen, the gas calorific value is greater than that using air; (2) The gasified zone is also greater. In the experimental apparatus the amount of oxygen used was 3.2 l/min, the length of borehole was 30 cm and diameter 1.2 mm. A product gas with a calorific value of more than 1000 kcal/N^3 was obtained during approximately 10 hours; and (3) By the use of oxygen, a desirable gas is obtained, but what quantity of gas can be generated and what reduction processes occur in the coal seam? Can the reaction speed in the gasification process of coal be obtained? A number of experiments concerning such problems were carried out in the laboratory and they will be reported in another paper. (auth)

8144 (UCRL-Trans—10989) **Underground gasification of coal.** Nakamura, H.; Irie, S. Translated from *Nenryo Kyokai-shi;* 44: No. 462, 684-696(1965). 65p. Dep. NTIS $4.50.

Since coal is assuming an important role as an energy source together with hydroelectric power in Japan, and in order to supply energy at low cost, coal mining companies are rationalizing the industry in many respects. Therefore, it is necessary not only to promote the mechanized extraction of coal, but also to study positively new means of coal extraction, namely, the underground gasification process and especially to establish methods suitable for the conditions of the country. On the basis of tests conducted in the coal fields, such an enterprise has been planned, and preliminary cost calculations have been made. According to estimates, the cost of gas from underground gasification for use in generating electrical energy shows great promise in enhancing the status of coal. (auth)

8145 (UCRL-Trans—10997) **Permissible flooding of coal seams under the conditions prevailing at the southern-Abinsk underground-gasification station.** Efremochkin, N.V.; Antonova, R.I.; Kreinin, E.V. Translated from *Tr. Inst. Proizvod. Opyt, Vses. Nauchno-Issled. Inst. Ispol'z. Gaza Nar. Khoz. Podzemn. Khraneniya Nefti, Nefteprod. Szhizhennykh Gazov;* No. 4, 177-182(1966). 11p. Dep. NTIS $3.50.

The stability of the underground gasification process is largely determined by the moisture available to the process from the water in the coal and rocks, including water in leakage to the reaction region. The calorific value of the gas is low if there is too much moisture and, in such cases, drainage may be required to improve the calorific value of the fuel. Some complications in the measurements are discussed and the method of using them to control the gasification process and calculate the drainage required are outlined. (LTN)

8146 PROCEEDINGS OF SIXTH SYNTHETIC PIPELINE GAS SYMPOSIUM, CHICAGO, ILLINOIS, OCTOBER 28—30, 1974. American Gas Association Catalogue No. L 51174. Arlington, VA; United States of America (USA); American Gas Association (1974). 444p. (CONF-7410147—). $40.00.

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

Twenty-four papers presented at the meeting were abstracted and indexed separately. (EJH)

8147 Status of CO_2 acceptor process. Fink, C.E.; Curran, G.; Sudbury, J.D. (Conoco Coal Development Co., Library, PA). pp 5-23 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The CO_2 Acceptor Process, a fluidized bed system to convert lignite or subbituminous coal into pipeline gas, is in its third year of pilot scale development. A series of successful fully integrated runs have demonstrated the technical feasibility of the process. A schematic diagram of the CO_2 Acceptor Process is shown. There are two fluidized bed reactors, a gasifier, and a regenerator which operate at a pressure of 150 psig. Lignite or subbituminous coal is fed to the bottom of the gasifier where, after rapid hydrodevolatilization, gasification of fixed carbon with steam occurs. The gasifier temperature is in the range of 1480° to 1550°F. Heat for the gasification reactions is supplied by a circulating stream of lime-bearing material called acceptor. The acceptor, which can be either limestone or dolomite, supplies heat needed for gasification principally by the exothermic CO_2 Acceptor reaction: $CaO + CO_2 = CaCO_3$; ΔH = -76,200 BTU/lb mole (77°F). The CO_2 Acceptor reaction is reversed in the regenerator at about 1850°F where heat is supplied by burning the residual char from the gasifier with air. Ash is removed from the regenerator by elutriation and collected via an external cyclone and lockhopper system. Seals between the gasifier and regenerator are maintained by purged standlegs of solids. Since the acceptor loses reactivity to the CO_2 Acceptor reaction as it circulates between the reactors, some of the circulating inventory purposely is withdrawn from the gasifier and replaced with fresh stone makeup. The makeup is added to the acceptor which is returning to the regenerator. (auth)

8148 A.G.A.-supported complimentary programs on coal gasification at IGT. Schora, F.C. Jr. (Inst. of Gas Tech., Chicago). pp 25-42 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The list of work being undertaken at IGT is identical to the list discussed in 1973. Certain of these programs are of a long-term nature. Other programs will soon reach decision points. At that time, the funding will be increased to ready the technology for commercial application, or funding will be terminated and other areas of investigation will be initiated. The programs in progress at IGT under A.G.A. sponsorship are: 1) R and D Survey of Coal Conversion to Gaseous and Liquid Fuels; 2) Solids Fluidization Relating to Coal Gasification; 3)Improved Shift Conversion Catalyst; 4) Acid-Gas and Trace Impurity Removal, 5) Kinetics of Devolatilization and Rapid-Rate Methane Formation Reactions; 6) Relation of Coal Properties to Gasification Reactivity; and, 7) Hydrogasification of Oil Shale. (EJH)

8149 There is more to a project than a process. Smith, S. (El Paso Natural Gas Co., TX). pp 43-50 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

In the 1930's, the high-pressure Lurgi coal gasification process was developed. To date, this process has been used successfully in 16 commercial plants in other countries, though not yet in the U.S. El Paso selected the Lurgi process in developing a large-scale, high-BTU gas facility. Commercial experience has

shown that the Lurgi coal gasification, shift conversion, gas purification and gas liquor separation units can work in combination with one another, and small commercial and pilot-scale methanation units have proved the commercial availability of methanation. In August 1971, El Paso announced that it intended to construct a large coal gasification complex on Company leased coal reserves on the Navajo Reservation in Northwestern New Mexico. This facility, named the Burnham Complex would be capable of producing 288 million cubic feet per day of pipeline quality gas. Since the Lurgi coal gasification process has not been used before in this country, three years of engineering design effort have been involved in the adaptation to a Burnham-sized commercial complex. (EJH)

8150 Status of the COGAS process. Bloom, R. Jr.; Eddinger, R.T. (Cogas Development Co., Princeton, NJ). pp 51-70 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The COGAS® Process converts coal to gas and oil products by taking advantage of the high efficiency of multi-stage fluidized-bed pyrolysis of coal, and the steam reactivity of the char from this pyrolysis. Further, the raw oil and synthesis gas products are produced in a low-pressure system without the use of an oxygen plant. In conducting its development program, COGAS Development Company has focused efforts on design, construction and operation of two pilot plant units to test two approaches to the gasification-combustion step, and on the necessary process engineering, preliminary design of a commercial-scale facility, and economic analyses. A status report on these activities, together with a description of the COGAS Process, is presented. The development program to date has demonstrated the technical and economic feasibility of the COGAS Process, and has shown it to be a viable competitor in the expanding field of coal gasification. COGAS Development Company is, thus, proceeding with continued pilot plant tests and further process optimization studies, and is planning for a demonstration plant having a feed capacity of 800-1000 tons of coal per day. (EJH)

8151 Many interfaces of energy. Hill, G.R. (Electric Power Research Inst., Palo Alto, CA). pp 71-76 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

This is a very general paper dealing with the importance of the subject and containing some comments on developments outside the United States. There is mention of the budget allocations at EPRI for various types of energy work, but no data are included. (EJH)

8152 Liquid phase methanation PDU results. Blum, D.B.; Frank, M.E.; Sherwin, M.B. (Chem Systems, Inc., Hackensack, NJ). pp 77-94 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The Liquid Phase Methanation Process is ideally suited to the safe and reliable conversion of high concentration carbon monoxide streams to methane. The exothermic heat of reaction, which under adiabatic conditions could theoretically cause temperature rises of about 1700°F in a non-recycle situation, is easily removed by the inert fluidizing liquid in a near isothermal system. This is achievable by effecting the heterogeneously catalyzed reaction of the feed gases in the presence of an inert liquid phase that absorbs the large exothermic heat of reaction. The reaction proceeds to near completion in a single pass and economic studies will dictate whether a single stage reactor or a polishing reactor should be utilized in the final design. (auth)

8153 Progress in fluidized-bed methanation. Diehl, E.K.; Stewart, D.L.; Streeter, R.C. (Bituminous Coal Research, Inc., Monroeville, PA). pp 95-112 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The objective of the BCR methanation program is to find the right combination of catalyst and operating conditions to effect a high conversion of carbon monoxide to methane in a single pass through the methanation reactor. The program is two-fold: 1) a broad range of catalysts is evaluated in bench-scale tests. These tests provide data on catalyst reactivity, temperature sensitivity, resistance to attrition, and catalyst life; 2) those catalysts that appear to meet the requirements of the Bi-Gas process are then tested in a fluidized-bed process development unit under actual Bi-Gas conditions. Design details of the process development unit being operated at BCR were given at the Fifth Synthetic Pipeline Gas Symposium last year. The purpose of this paper is to describe the test procedures followed in the course of the experimental program and to report the result of some recent experimental runs. (auth)

8154 OCR demonstration plant program. Cochran, N.P. (Office of Coal Research, Washington, DC). pp 113-118 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

8155 Status of Battelle/Union Carbide process development unit installation. Corder, W.C.; Goldberger, W.M. (Battelle Columbus Labs., Columbus, OH). pp 139-158 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The Agglomerating Burner-Gasification Process is a pressurized, two-stage, fluidized-bed system involving combustion of coal or char in one fluidized bed and the steam gasification of coal in a separate fluidized bed. The heat for the gasification reactions is provided by circulation of ash from the burner to the gasifier. A key feature of the process is the application of the self-agglomerating method of fluidized-bed combustion. The self-agglomerating method of fluidized-bed combustion consists of operation of the fluidized-bed burner under temperature and velocity conditions such that the fly ash in the coal is agglomerated or pelletized in a controlled way into free-flowing, inert solid pellets. These pellets or ash agglomerates serve as a moving burden, direct-contact, heat-transfer medium. The process is believed to be suitable for gasification of a variety of feed materials including Eastern and Western coals and lignites or coal chars. Two significant advantages are offered by the process: 1) the agglomerating action which takes place in the burner serves to collect the ash to yield a combustion gas sufficiently free of fly ash to allow direct expansion of the combustion gas in a turbine for recovery and reuse of energy and 2) use of the circulating ash agglomerates to supply heat in the gasifier eliminates the need for partial oxidation and, thus, the need for an oxygen plant. (auth)

8156 Coal gasification research at General Electric: past and present. Bueche, A.M.; Kydd, P.H. (General Electric Co., Schenectady, NY). pp 159-186 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

General Electric has been involved in coal gasification research since 1945 with the objective of providing a clean fuel for gas turbines. Major projects have been undertaken on a fixed bed gasifier, a fluid bed carbonizer, and an entrained bed gasifier with super-charged boiler. Following a review of the experiences of General Electric and others in 1970 the present research program was begun with the primary objectives of adapting the fixed bed gasifier to a wider range of fuels and simplifying the gas cleaning plant. (auth)

8157 Pictorial tour of the Synthane pilot plant. Torkos, T.; Lewis, R. (Bureau of Mines, Pittsburgh). pp 187-215 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The major portion of this report consists of 79 photographs of various components of the plant. There is also a brief description of the various stages of the process. The cost of the plant is about $13,000,000, and the annual operating cost is expected to be about $5,000,000. (EJH)

8158 SNG production based on Koppers-Totzek coal gasification. Franzen, J.E.; Goeke, E.K. (Heinrich Koppers GmbH, Essen). pp 217-234 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

A new technology for the production of pipeline gas from coal is explained, and the technical features of the new Koppers SNG Process are described. Some data regarding the economics of this process are given. The Koppers SNG Process essentially includes four stages: 1) gasification of coal via the Koppers-Totzek Process; 2) gas preparation for further treatment, including dedusting (mechanically or by electrostatic precipitation), compression, desulfurization; 3) combined carbon monoxide-shift conversion and methanation, a new joint development of Heinrich Koppers and Imperial Chemical Industries (ICI) Billingham, Great Britain; and 4) carbon dioxide removal for establishing the desired calorific value of the gas, followed if necessary by a gas drying step and gas compression. (auth)

8159 Results of trials of American coals in Lurgi Pressure-Gasification Plant at Westfield, Scotland. Elgin, D.C.; Perks, H.R. (Scottish Gas Board, Edinburgh). pp 247-268 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The gasification trials at Westfield on behalf of the A.G.A. have achieved the specified objectives, as set out below in corresponding order: 1) gasification of all four coals has been achieved. This covers not only the caking coals from the Eastern United States but also includes a Western subbituminous coal, not scheduled originally; 2) the highest swelling and caking coal, Pittsburgh 8 (F.S.I. $7^1/_2$, Caking Index 30) was gasified both in graded form and with 23.6 percent material below $^1/_4$" square mesh; 3) since all coals were gasified, it is not necessary to specify an acceptable limit for the proportion of fines below the normal figure for run-of-mine coal; and 4) the tests yielded comprehensive sets of data of the type required in preparing performance guarantees. It is, of course, for Lurgi to comment on their acceptability as a basis for a commercial design. (auth)

8160 Processing of American coals in a Lurgi gasifier. Rudolph, P.F.H. (Lurgi Mineraloltechnik GmbH, Frankfurt am Main). pp 269-282 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

A review is given of the activities in the field of Lurgi Pressure Gasification of coal during the past year. A very essential result is the demonstration that the process is capable of successfully gasifying U.S. coals. Substantial progress has been made that will benefit the pending projects and that moreover extends the fields of application for the process considerably. (auth)

8161 Westfield Development Centre: concept and facilities. Scott, J. (British Gas Corp., Westfield, Scotland). pp 283-296 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The circumstances leading to the establishment of the Westfield Development Centre, which came into being as a coal gasification research, development and demonstration facility on 1st August, 1974, are outlined. The Centre is under the management of the Production and Supply Division and under the technical direction of the Research and Development Division of the British Gas Corporation. It was born from a recognition of the need to supplement the supplies of natural gas in the United States where demand has outstripped supply, and the existence of resources of technology, plant and manpower within the British Gas Industry which could assist in developing processes capable of contributing to the satisfying of this need. The location of the Centre, proposed staffing, services available, major equipment installed, and the processes which have been in use for gasification, purification, and more recently methanation, are all briefly described with a view to providing a broad picture of the overall facilities available. The paper touches on the A.G.A. coal trials and the Conoco Methanation project and concludes with a discussion of additional projects which might be considered at Westfield both in the short term to run concurrently with the development of the slagging gasifier or subsequent to this project in order that the facilities are utilized to their fullest extent. (auth)

8162 Review of methanation demonstration at Westfield, Scotland. Landers, J.E. (Conoco Coal Development Co., Ponca City, OK). pp 297-304 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

Tests included varying the gas composition, recycle rates, temperature levels, water content, and impurity levels. Small bench-size reactors both in Scotland and in the Ponca City, Oklahoma laboratory have been used. Long-term catalyst durability data was obtained on the small scale units. Production of SNG averaged 2.1 MMSF/SD during the month of September, 1974. The average calorific value of gas produced was 979 BTU/scf with a standard deviation of 5 BTU/scf. The interchangeability of SNG with natural gas was confirmed in combustion tests run by Scottish Gas Region on ranges, water heaters, and room heaters. The ultimate test was met when consumers in the area used the SNG in their appliances. (auth)

8163 Materials engineering and development of the Office of Coal Research. Frankel, H.E.; Raring, L.M. (Office of Coal Research, Washington, DC). pp 305-311 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The work plan is presented under the following main headings: coal handling technology; coal gasification; coal liquefaction; combustion; and power conversion. The information is presented in the form of a table, and projections are made through fiscal year 1979. Schedules, priorities, funding, and integration of programs are discussed. (EJH)

8164 Mechanical design considerations in commercial scale coal gasification plants. Howell, R.D. (C.F. Braun and Co., Alhambra, CA). pp 317-338 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

One of the primary efforts of the program is the conceptual design and economic evaluation of commercial scale plants based on the processes being developed by the Office of Coal Research and the American Gas Association. Some of the design considerations and problem areas for commercial-size coal gasification plants are presented. (EJH)

8165 Materials in coal gasification. Howes, M.A.H.; Parikh, N.M.; Bangs, E.R.; Schaefer, A.O. pp 349-368 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The extremes in atmospheres, temperatures, and pressures in coal gasification equipment impose severe demands on the materials of construction. To develop reliable data on the behavior of materials of construction in coal gasification environments, the American Gas Association through The Metal Properties Council, Inc. has initiated a multiphase program of research with IIT Research Institute. The first phase is a laboratory screening study of corrosion of materials of construction, such as stainless steels and nickel alloys, in a high pressure (1000 psi), high temperature (up to 2000°F) gasifier environment. The second phase includes a comprehensive exposure and examination of metals and refractories in all the pilot plants. The third phase covers the screening of alloys of construction in the laboratory in aqueous quench tower liquids contained in the autoclaves at high (up to 1500 psi) pressures. The fourth phase is a combined erosion-corrosion study and the fifth phase is the collection of engineering data on the most promising materials. The details of the first three phases are discussed. (auth)

8166 Status of HYGAS program. Lee, B.S.; Tarman, P.B. (Inst. of Gas Tech., Chicago). pp 369-388 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The major activities and goals in the HYGAS Program are: After demonstrating the feasibility of the HYGAS Process on a pilot scale, the integration of a char-based hydrogen-generation scheme with the HYGAS Process is the first priority goal. After extensive evaluation, the steam-oxygen gasification of hydrogasified char was chosen to be the first method integrated with the HYGAS unit. Equipment necessary for this integration was built and shaken down. The electrothermal gasification method of generating hydrogen was considered to be less attractive than steam-oxygen gasification in view of the rapid increases in power-generation costs. After successful demonstration of the

technical feasibility of this approach, extensive testing of the electrothermal gasification concept was deferred. The steam-iron method of hydrogen generation, which potentially has both economic and technical advantages over other hydrogen-production methods, will be tested in a pilot plant now under design and construction. An ash-agglomerating gasification system was built and operated to successfully demonstrate this method of improving overall carbon utilization and to eliminate the problem of handling high-ash-content fines. This concept is applicable to both the steam-oxygen and the steam-iron methods of hydrogen generation. (auth)

8167 Coal-technology's wonderful gas well. Bagge, C.E. (National Coal Association, Washington, DC). pp 389-398 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

8168 CLEAN FUELS FROM COAL. SYMPOSIUM II HELD AT CHICAGO, ILLINOIS, JUNE 23—27, 1975. Chicago; United States of America (USA); Institute of Gas Technology (1975). 912p. (CONF-7506102—). $50.00.

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

Forty-three papers are included in this publication. Of these, 14 were included in the publication resulting from the first symposium (CONF-7309113) and are listed in Coal Processing: Gasification, Liquefaction, Desulfurization, A Bibliography 1930-1974 (TID-3349). Five of the remaining papers resulted from ERDA-sponsored work, and an abstract is included for each of them. Abstracts of three other papers are included for EAPA.

8169 Clean fuels from coal. Technical-historical background and principles of modern technology. Bodle, W.W.; Vyas, K.C.; Talwalkar, A.T. (Inst. of Gas Tech., Chicago). pp 53-84 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

8170 Fuel gas from coal. Rudolph, P.F.H.; Bierbach, H.H. (Lurgi Mineraloeltrechnik GmbH, Frankfurt am Main). pp 85-99 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Supplementary stack gas clean-up is one way to meet today's environmental requirements for coal fired power plants. A better and more efficient alternative, though, is the production of a clean fuel gas in the first place with gasification being the first step. Gas purification processes are available to achieve the necessary degree of purity and, to adjust the desired calorific value of the clean fuel gas. For power plant or industrial use the substitute for natural gas need not necessarily be SNG but can also be a fuel gas of medium or low BTU level with less stringent requirements as to the degree of purity. Alternatively, a co-production of a storable clean fuel, e.g. methanol, is possible. Advantages of the fuel gas from coal routes include lower capital requirements and gas production costs, as well as higher efficiencies in the case of combined power cycles using low BTU gas as fuel. (auth)

8171 Koppers—Totzek (K—T) process and its application to industrial needs. Whiteacre, R.W. III; Farnsworth, J.F.; Mitsak, D.M. (Koppers Co., Inc., Pittsburgh). pp 107-130 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The Koppers-Totzek (K-T) Coal Gasification Process, which is commercially proven, offers a pollution-free means of utilizing the country's extensive coal resources. This paper briefly summarizes the historical background of the K-T Process, a description of the process and plant design, process features, product applications and cost data. (auth)

8172 GEGAS Process. Kydd, P.H. (General Electric Co., Schenectady, NY). pp 131-147 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The GEGAS Process is described in detail relative to a number of characteristics such as process variables and suitable feed stocks. Particular attention is paid to two new technologies, high pressure coal extrusion, and membrane gas cleaning, as they may impact the production of clean fuels from coal. In conclusion, the potential for production of electricity and substitute fuel gas from the same plant is considered as a means of securing better equipment utilization.

8173 SYNTHANE process. Haynes, W.P.; Forney, A.J. (Pittsburgh Energy Research Center). pp 149-157 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The SYNTHANE process for converting both caking coals and noncaking coals to substitute natural gas is described briefly. Typical compositions of the synthesis gas and condensate from the 4-in. dia pilot plant gasifier are presented. Some of the major features to be demonstrated in the 72-ton-per-day pilot plant are also discussed. (auth)

8174 HYDRANE process. Gray, J.A.; Yavorsky, P.M. (Pittsburgh Energy Research Center). pp 159-176 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The HYDRANE process, being developed by the ERDA Pittsburgh Energy Research Center, yields a pipeline quality gas by reaction coal directly with hydrogen. Over 90% of the methane product is made in this single step without any pretreatment and consequently makes HYDRANE the most thermally efficient high-Btu gasification process. More extensive development is needed now in a large process development unit to prove the scale-up of the dilute phase reactor and to operate a completely integrated and thermally self-sustaining system. Laboratory work to data has been extensively concerned with the dilute phase reactor operation and to some extent with hydrogasification of the char produced in the dilute phase reactor. Some two-stage experiments have been conducted where the operation was integrated with respect to solids flow, but not with respect to interstage gas flow. As a first step in the scale-up, the feasibility study of HYDRANE has been completed, and the technical packages for the contracting of the detailed engineering design of the Morgantown PDU are being prepared. The PDU is expected to be about 20 TPD and cost $18 MM. (auth)

8175 HYGAS Process. Anastasia, L.J.; Bair, W.G. (Inst. of Gas Tech., Chicago). pp 177-192 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The present status of the HYGAS Process development is highlighted by a summary of operating results for the catalytic methanation system using lignite coal as feed. A thorough analysis of solids flow in the hydrogasifier was required to determine the effects of coal fines circulating around but never leaving the upper reactor stages. The fines overloaded reactor transfer lines and limited coal feeding to rates much lower than the design rate of 3 tons/hr. To ensure removal of the fines and improve coal feed rates, the hydrogasifier was modified to increase superficial gas velocity in the slurry dryer bed. An important milestone in the HYGAS program was recently achieved: The entire plant was operated using the integrated steam-oxygen gasifier for hydrogen synthesis gas with no external heat or hydrogen feed supplied to the reactor. The achievements mark the first time a U.S. coal has produced SNG in a new-generation process on an integrated pilot-plant scale.

8176 IGT U-GAS Process. Patel, J.G.; Loeding, J.W. (Inst. of Gas Tech., Chicago). pp 193-206 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

As one outgrowth of its 25 years experience in coal-conversion processes, the Institute of Gas Technology has conceived a coal-to-low-Btu gas process referred to as the U-GAS Process. In this environmentally acceptable concept, crushed coal is contacted in a fluidized-bed gasifier with steam and either air or oxygen. Gasifier pressure is about 300-350 psig, and bed temperature is about 1900°F. After sulfur and particulate removal, the product gas may be used in a retrofit mode to fuel existing boilers, as fuel for a combined cycle system to produce power, or as the energy input to an industrial complex. Preliminary cost estimates indicate substantial cost savings are possible, compared with other energy forms; process studies indicate a significantly higher conversion efficiency than is customary in present-day power plants.

8177 CO_2 Acceptor Process Pilot Plant, 1974, Rapid City, South Dakota. Fink, C.; Curran, G.; Sudbury, J. (Conoco Coal Development Co., Library, PA). pp 243-257 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Since last October, seven runs have been made bringing the total number of runs made in the pilot plant since April of 1972 to 21. Each of these seven runs was of sufficient duration to provide process data and important operating experience. This successful series of runs was culminated with a run which featured: 251 hours of integrated plant operation at process temperature; 244 hours using Velva lignite as feedstock; 171 hours in which the circulating acceptor supplied the entire gasifier heat duty; a demonstrated process efficiency of 77%. The successes achieved in the past year can be attributed to four main factors. First, most of the major mechanical problems in the plant have been solved. Second, a new start-up procedure using dead-burned dolomite as the initial acceptor inventory is being used. This has eliminated plugging problems which plagued earlier operations. A mathematical model of the process was used as a guide to pilot plant operations. (auth)

8178 Methanation catalysts evaluation program at IGT. Lee, A.L. (Inst. of Gas Tech., Chicago). pp 259-270 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

8179 Synthetic fuels from coal the Garrett process. Green, N.W. (Garrett Research and Development Co., Inc., La Verne, CA). pp 299-322 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Garrett Research and Development Company, Inc. is developing the "FLASH PYROLYSIS" process for the conversion of coal into synthetic fuels. The process can be adapted for the production of either gaseous or liquid fuels, depending on the nature of the source coal and the demand for end products. The char residue is completely acceptable as a solid fuel in the stationary power plants. The process is discussed in terms of its application to specific source coals.

8180 New applications of the Fischer—Tropsch process. Hoogendoorn, J.C. (South African Coal, Oil and Gas Corp. Ltd., Sasolburg). pp 343-358 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The Fischer-Tropsch process is a simple and proved process to produce synthetic hydrocarbons and chemicals from hydrogen and carbon monoxide. The synthesis gas can be obtained by gasification of coal and reforming of natural gas. The paper gives some characteristics of the process and compares the production of methanol with the production of Fischer-Tropsch hydrocarbons as a means to use remote natural gas.

8181 Methanol from coal with Winkler synthesis gas. Eastland, D.H. (Davy Powergas, Inc., Houston, TX). pp 375-395 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Synthetic methanol has been manufactured from gaseous liquid and solid feedstocks. These are briefly reviewed with an outline of the coal gasification processes which have been used since the early 20's. The Winkler process can be applied to current U.S. conditions and production costs improved by pressurization. A typical 5000 tons/day methanol from coal installation is described using the ICI LP methanol process and operating data and costs outlined based on January 1975 estimates.

8182 Application of molten salt gasification to combined cycles. Fraley, L.D.; Kumar, C.A. (M.W. Kellogg Co., Houston, TX). pp 397-410 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The Kellogg Molten Salt Process currently under development, converts high sulfur coal to clean fuel gas with a heating value of 100 to 150 Btu/SCF with air as a gasification medium. A power plant with a heat rate of 8500 to 9500 B/kw/hr results when the Kellogg Molten Salt Gasification process is integrated with a present day combined power cycle.

8183 Degasification of coalbeds: a commerical source of pipeline gas. Deul, M.; Fields, H.H.; Elder, C.H. (Bureau of Mines, Pittsburgh). pp 615-623 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

A byproduct of intensive research conducted by the Interior Department's Bureau of Mines on degasification of coalbeds for improved mine safety is evidence that commercial quantities of pipeline quality natural gas can be produced. Coalbed degasification by draining gas from the coalbed before it is mined can be accomplished by drilling vertical holes into coalbeds with subsequent stimulation by hydrofracturing; by drilling horizontal holes into virgin coalbed areas from small specially designed boreholes so that drainage holes from large ventilation shafts sunk to the coalbed in advance of mining. It is estimated that the minable coalbeds of the conterminous United States that are less than 3,000 feet deep may contain 260 trillion cubic feet of natural gas. The pertinent coalbed properties are discussed and results of a novel drilling method are presented.

8184 Underground gasification of coal. Nadkarni, R.M.; Bliss, C.; Watson, W.I. (Arthur D. Little, Inc., Cambridge, MA). pp 625-651 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

A survey of past technology and the technical problem areas are surveyed, some solutions are suggested, and an introductory exploration of the economic competitiveness of the technology is undertaken. Preliminary calculations are presented which indicate that in the current U.S. energy supply/demand picture, underground gasification appears to be a viable competitive energy source. This suggests that further experimentation to develop this approach to a commercial stage is justified.

8185 Purification of intermediate streams in coal gasification. Fleming, D.K. (Inst. of Gas Tech., Chicago). pp 653-680 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Conventional purification processes are applicable to treat intermediate gas streams of processes that produce both high- and low-Btu gas from coal. Process requirements dictate that the high-Btu gas stream must be extremely pure; however, the low-Btu gas need only be purified for environmental considerations. The environmental constraints and their influence on process economics must be considered in conjunction with the alternative, but similar overall system of burning the coal directly and utilizing known stack-gas desulfurization technology to protect our environment. High-temperature processes, now under development to desulfurize low-Btu gas, appear to be capable of purifying the gas so that combustion will result in emissions equivalent to those when the coal is burned directly in compliance with present Federal standards. In the production of high-Btu gas or chemicals from coal, the anticipated emissions are approximately an order of magnitude less than those created in the production of an equivalent amount of electrical energy. Purification processes appear to be available so that most of the potential impurities in the initial coal can be recovered in environmentally satisfactory forms, with relatively low losses of sulfurous compounds to the atmosphere. Further, we anticipate that the water balance around the future coal conversion facility can be closed, without discharge to the local watershed.

8186 City College Clean Fuels Institute: programs for (I) gasification of coal in high-velocity fluidized beds and (II) hot gas cleaning. Squires, A.M. (City Coll., New York). pp 681-731 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

(I) High-velocity fluidized beds (10 to 40 ft/sec have been used successfully for (a) total gasification of coal with air and (b) substantially total gasification with steam and oxygen. In addition to the obvious advantage of high capacity, high-velocity fluidized beds are relatively immune from trouble if sticky solids are present. The Godel phenomenon can serve to remove ash agglomerates of low carbon content from a bed rich in carbon. A caking coal can be introduced into such beds with impunity: In particular finely pulverized caking coal can be introduced into a

bed of large coke beads with growth and production of the beads. A fast fluidized bed of fine coke particles will provide excellent contact between solid and gasification medium. The panel bed filter with puffback cleaning appears capable of removing dust at high efficiency from a hot fuel gas.

8187 Corrosion and hydrogen embrittlement in coal gasification environments. Parikh, N.M. (IIT Research Inst., Chicago); Samans, C. pp 751-794 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The extremes in atmospheres, temperatures, and pressures in coal gasification equipment impose severe demands on the materials of construction. Some of the expected problem areas related to material degradation are described and different types of corrosion phenomena and the underlying causes are discussed briefly. A comprehensive on-going program of evaluation of materials in different coal gasification environments is considered.

8188 Construction of coal conversion vessels. Hicklen, W.L. (Chicago Bridge and Iron Co.). pp 795-816 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

8189 Commercial coal conversion plant design: translation from pilot to commercial-scale plants. O'Hara, J.B.; Jentz, N.E.; Hervey, G.H. (Ralph M. Parsons Co., Pasadena, CA). pp 817-837 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Key elements of translation and scale-up programs are summarized. Fundamentals of translating pilot plant experience to commercial plant design are discussed. Factors considered include early definition of commercial plant objectives, basic data requirements, and scale-up criteria. Pilot plant data/information supply and analysis require cooperation between client, process developer, and plant designer. The interactions between the process development and the plant design schedules are discussed. Procedures for analysis of the pilot plant results and development of commercial plant design basis are described. An illustration of the application of a translation/scale-up program is given. These procedures are useful for preliminary and conceptual designs of commercial coal conversion plants. The most important report on the subject will follow successful design, construction, and operation of demonstration and commercial-scale plants.

8190 General facilities offsite and utilities for coal gasification plants. Strasser, J.D. pp 839-852 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The General Facilities Offsite, and Utility Units for a Lurgi Coal Gasification Plant are reviewed based on the Western Gasification Company Plant. Capital costs are outlined.

8191 Financing coal gasification projects. Bellas, A.C. (Goldman, Sachs and Co., New York). pp 853-859 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

To a large extent, the problems of financing a coal conversion project are not unusual except for the magnitude of the dollars involved. The story of financing large-scale projects is a story of risk analysis and the special risk-protection techniques that the lenders insist on being designed into any financing plan before they agree to part with their money. The special financing techniques and how the financing considerations change as a company considers projects of progressively larger size are described. An overall gas industry capital budget inconsistent with industry's credit capacity may be the controlling factor in making the private financing of gasification plants impossible. Either some projects will not get built, particularly SNG plants, the most capital-intensive of gas sources, or government aid will have to be sought. In case government credit is to be sought, many models exist for the form it should take. The author believes that it would be a mistake to seek special legislation for an aid program that is aimed at a single type of energy project; rather the best strategy would be to encourage legislation that would make available government aid to large-scale energy projects generally, including gasification. (MCW)

8192 Government energy policies and the Demonstration Plants Program. Cochran, N.P. (Energy Research and Development Administration, Washington, DC). pp 861-867 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Government energy policies and ERDA's Demonstration Plants Program have evolved within a framework of events and issues that have brought about the present energy challenge facing the nation. Since the early 1900's the demand for energy has been growing rapidly in the United States, reaching a current rate of between 4 and 5%. Today, even with the recession and temporary reductions in overall energy use, U.S. per capita energy consumption is eight times the world average. Until 1960 the United States was energy self-sufficient; today, foreign oil accounts for 37% of total U.S. energy consumption. This dependence is the direct result of increasing demand, low cost of imported oil, and a deterioration in supply, exploration, and utilization of domestic fossil-fuel resources. As a consequence, 46% of U.S. energy comes from oil, 32% from natural gas, only 18% from coal, in site of the fact that coal is the most abundant fossil fuel. The Demonstration Plants Program is moving forward in a positive way to assist in meeting this nation's energy needs; to reduce our dependence on imported oil; and to produce liquid and solid fuels as well as gas, that will not only meet environmental standards, but at a cost competitive with current natural gas and petroleum products. (auth, abstract modified)

8193 Union Carbide's "coalcon" process. Martin, J.R. pp 869-904 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

8194 Methanation in coal gasification processes. Strakey, J.P.; Forney, A.J.; Haynes, W.P. (Energy Research and Development Administration, Pittsburgh). pp vp of In Second annual symposium on coal gasification, liquefaction, and utilization: best prospects for commercialization. Pittsburgh; Univ. of Pittsburgh (1975).

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

See CONF-750868—.

NONE

8195 Behavior of caking coals in fixed-bed gasifiers. Liberatore, A.J.; Gillmore, D.W. (Morgantown Energy Research Center, WV). pp vp of In Second annual symposium on coal gasification, liquefaction, and utilization: best prospects for commercialization. Pittsburgh; Univ. of Pittsburgh (1975).

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

See CONF-750868—.

Low-Btu gas from high sulfur coal offers a promising method of producing an economical and environmentally acceptable fuel for utility plants. Low-Btu gas is envisioned for use in conventional steam boilers operating at atmospheric pressure or in advanced, combined gas-steam turbine cycles at elevated pressures. Previous research at the Morgantown Energy Research Center with a 42-in. diameter, stirred fixed-bed gasifier, showed that deep continuous stirring of the fuel bed facilitated gasification of caking coals. Stirring breaks up agglomerates and fills void spaces in the bed, thereby promoting better gas-solid contact. Stirring also prevents the formation of massive clinkers, thus facilitating the passage of ash and clinkers through the grate. Two highly caking coals from West Virginia, Pittsburgh and Upper Freeport seams, and a moderately caking coal, Western Kentucky No. 9 seam, were investigated in the MERC gas producer up to 200 psig. Low-Btu gas production was 65-80 scf/lb of moisture- and ash-free coal over a wide range of variables, depending upon the particular coal, while heating values were 130-170 Btu per scf. The effect of pressure gas production could not be determined since pressure could not be varied independently; pressure increased as air and steam rates were increased, thus consuming more coal and producing more gas. However, coal consumption can be correlated with air rate, and such a relationship is illustrated. The correlation is based on results at pressures ranging from 15 to 210 psig. Producer gas composition varies but is essentially independent of operating conditions and type of coal, except for hydrogen sulfide content. A typical analysis is given. (auth)

8196 ERDA fossil energy coal conversion and utilization. pp vp of In Second annual symposium on coal gasification, liquefac-

tion, and utilization: best prospects for commercialization. Pittsburgh; Univ. of Pittsburgh (1975).

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

See CONF-750868—.

This report consists of an outline and representations of slides for the coal utilization program covering such subjects as the objective, strategy, organization charts, budget summaries, funding curves, power and combustion test facility program, fluidized-bed combustion, high Btu gasification, low Btu gasification, coal liquefaction, demonstration plant program, boiler fuel project, and the coal hydrocarbonization process. (EJH)

8197 Mathematical modeling of the stream method of underground coal gasification. Magnani, C.F. (Chevron Oil Field Research Co., La Habra, CA); Farouq Ali, S.M. *Soc. Pet. Eng. J.*; **15**: No. 5, 425-436(Oct 1975).

This investigation focuses on mathematical modeling of the process of underground gasification of coal by the stream method. A one-dimensional, steady-state model consisting of five coupled differential equations was formulated, and the solution, extracted analytically, was used to develop closed-form expressions for the parameters influencing coal gasification. The model then was used for interpreting field performance curves, predicting the results of the field tests, and ascertaining the over-all process sensitivity to the input variables. The usefulness of the model was shown by establishing the parameters influencing the success or failure of an underground gasification project. (auth)

8198 Resource utilization during the underground coal gasification experiments at Hanna, Wyoming. Boyd, R.M.; Fischer, D.D. (Energy Research and Development Administration, Laramie, WY). *Trans. Am. Nucl. Soc.*; **22**: 4(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

8199 Diagnostic measurements for field research on in-situ energy conversion. Reed, R.P. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.*; **22**: 5(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

8200 Coal fracture measurements by electrical methods. Lytle, R.J. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.*; **22**: 6(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

8201 Process for making liquid and gaseous fuels from caking coals. Rice, C.H. (to Consolidation Coal Co.). US Patent 3,920,418. 18 Nov 1975. Filed date 10 Sep 1973. 8p.

An improvement in the process for converting coal to liquid and gaseous fuels wherein solvent extraction is used for the recovery of a liquid-rich fraction and a solids-rich fraction is described. The latter is converted by carbonization to an extremely finely divided char which is formed into agglomerates that are then further carbonized and finally gasified. (auth)

8202 Method of gasifying carbonaceous material. Fernandes, J.H. (to Combustion Engineering, Inc.). US Patent 3,920,417. 18 Nov 1975. Filed date 29 Jun 1973. 8p.

A method and apparatus is disclosed for generating a clean, low-Btu fuel gas by the reaction of a carbonaceous fuel limestone mixture with oxygen and steam in a downdraft fixed bed gasifier. The product gas and slag are discharged from the lower end of the gasifier after having passed through an incandescent char matrix in which contaminants such as sulfur are scrubbed from the gas. A portion of the hot product gas is withdrawn from the upper end of the gasifier to dry, preheat, and devolatilize freshly introduced fuel material. This gas which contains a heavy oily emulsion of tars and sulfur compounds is then reintroduced into the gasifier. The gasifier is capable of gasifying essentially any hydrocarbon material such as refuse, lignite, anthracite, bituminous coal, coke, oil, liquid waste and many others, including manure and other farm waste. (Official Gazette)

LIQUEFACTION

REFER ALSO TO CITATION(S) 8132, 8139, 8146, 8163, 8169, 8189, 8192, 8196, 8201, 8219, 8225, 8822

8203 (ERDA—76-35) **Economic analysis of synthoil plant producting 50,000 barrels per day of liquid fuels from two coal seams: Wyodak and Western Kentucky.** (Bureau of Mines, Morgantown, W.Va. (USA)). Nov 1975. 104p. (FE—2083-1). Dep. NTIS $5.50.

An integrated plant to produce 50,000 barrels per stream day of heavy fuel oil, low in sulfur, by the hydrogenation of coal is described. The capital cost is estimated at $661,366,000. The selling price of the fuel oil is in the range of $15 to $25/BBl for the assumed discounted cork flow rates (12 to 20%) and cost of coal ($5 to $9/ton). (LTN)

8204 (ERDA—114-75/1, pp 5-9) **Char-oil energy development (COED).** (FMC Corp., Princeton, NJ). 1975.

In Coal liquefaction. Quarterly report, January—March 1975.

Work during the first quarter of 1975 concentrated on concluding pilot plant work and continuing technical and economic research into commercial plant scale-up. The pilot plant activities focused on filtration, hydrotreatment, gasification, and mothballing. The commercial plant scale-up work concentrated on the development of a cost analysis program. Specific tasks included: filtration and hydrotreatment of the remaining oil derived from Pittsburgh seam coal; hydrotreatment of the remaining filtered pyrolysis oil derived from western Kentucky coal after mechanical problems with the hydrogen recycle compressor were resolved; gasification tests of COED char; shutdown and mothballing of the pilot plant filtration and pyrolysis units; and development of a computer program to analyze the cost of producing COED fuel gas in a commercial plant. (auth)

8205 (ERDA—114-75/1, pp 15-18) **Synthoil process.** (Foster Wheeler Energy Corp., Livingston, NJ). 1975.

In Coal liquefaction. Quarterly report, January—March 1975.

During the first quarter of 1975, work on the Synthoil process concentrated on two major areas: design of the process development unit, and laboratory research. Foster Wheeler continued the architectural and engineering design of the Synthoil 10-ton-per-day process development unit on schedule. Laboratory research conducted at PERC concentrated on further technical development of the Synthoil process, with particular emphasis on catalysts. Testing, using the 1/2-ton unit, continued in order to (1) compare the performance of new catalysts to that of the Harshaw 0402T catalyst now being used, (2) test different types of coal, (3) determine the characteristics of filtration operation, and (4) study the reaction mechanism. (auth)

8206 (ERDA—114-75/1, pp 19-25) **H-Coal process.** (Hydrocarbon Research, Inc., Trenton). 1975.

In Coal liquefaction. Quarterly report, January—March 1975.

HRI emphasized the design and engineering of the coal preparation, coal hydrogenation, and off-site sections of the pilot plant. In the coal hydrogenation section, particularly, extensive engineering changes were made to the overhead stream, makeup hydrogen, and cooling systems; the water separators; and the construction materials for the reactor. Changes resulting from a review process and the possibility of using a different plot of land closer to the Ashland Oil refinery for constructing the pilot plant resulted in delays in the project schedule. Use of this new plot may result in lower capital and operating costs but will necessitate some layout changes. A new mechanical completion date is being negotiated with the government. Laboratory research included modifications and operation of the process development unit, with emphasis on the effect of recycle gas rates on the catalyst-bed level. In other studies, sintering was found to be the major cause of catalyst deactivation when processing subbituminous coals under H-Coal operating conditions, and metal deposition was a significant cause when processing bituminous coals. Methods of solids separation (filtration, magnetic separation, and centrifugal separation) were also studied. (auth)

8207 (ERDA—114-75/1, pp 27-30) **Cresap test facility.** (Fluor Engineers and Constructors, Inc., Los Angeles). 1975.

In Coal liquefaction. Quarterly report, January—March 1975.

During this quarter, the design and engineering for the renovation of the ERDA-owned facility in Cresap, West Virginia, included (1) the expedition of mechanical design and procurement efforts; (2) the issuance of a major portion of process data sheets and work orders to the pilot plant in Cresap; (3) the completion of the process designs for the coal handling, extraction, solids separation, and fractionation units; (4) completion and submission to ERDA of the renovation budget estimates. Major test parameters and a preliminary test plan outline were defined for equipment testing at the pilot plant. Cost estimates for each test element were in preparation. (auth)

8208 (ERDA—114-75/1, pp 39-41) **R and D engineering services.** (Holifield National Lab., Oak Ridge, TN). 1975.

In Coal liquefaction. Quarterly report, January—March 1975.

The review and evaluation of existing process technology were completed on schedule, and a summary report was submitted to ERDA for review and comment. The experimental development work continued with emphasis on high-temperature hydrocarbonization studies. The first carbonization run using the high-temperature atmospheric pressure apparatus was completed successfully. A second run was conducted and several modifications to this apparatus were completed. The conceptual design of the bench-scale hydrocarbonization system was completed. In addition, drawings were submitted for pressure vessel review, available materials were inventoried, and a fabrication schedule was established. (auth)

8209 (FE—1224-49) **Project Lignite. Quarterly technical progress report No. 6, July—September 1975.** Severson, D.E. (North Dakota Univ., Grand Forks (USA). Engineering Experiment Station). 22 Dec 1975. Contract E(49-18)-1224. 50p. Dep. NTIS $4.00.

Progress is reported in developing data and know-how for the refinery processes involved in creating premium solid, liquid and gaseous fuels from lignite. Laboratory and bench-scale work have been carried out and a layer process development unit is undergoing shakedown runs. A number of equipment failures have prevented the completion of these runs. Some of the failed equipment is being replaced with Incoloy 800, which is resistant to stress corrosion cracking. New laboratory liquefaction results are reported. The estimated capital and operating costs of a plant for making synthesis gas are 3-1/2 times those estimated earlier, due to the inclusion of more areas and an increase in the cost of those areas considered previously. Operating costs are lower in North Dakota due to lower raw material and labor costs. (LTN)

8210 **Conversion of coal to oil and other liquids at Bureau of Mines.** Harney, B.M. (Bureau of Mines, Washington, DC). pp 119-133 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

The Bureau of Mines program is aimed at the development of two promising coal conversion processes, Synthoil and Costeam, as well as research on novel processes for increased efficiency and improved economics. A program on refining synthetic fuel will determine data required for producing distillate products from synthetic crudes. Finally, a comprehensive program on support research and development will provide backup efforts needed for the liquefaction program with special emphasis on materials and equipment development and environmental analysis. (auth)

8211 **SYNTHOIL process.** Friedman, S.; Yavorsky, P.M.; Akhtar, S. (Pittsburgh Energy Research Center). pp 481-494 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

The SYNTHOIL process for the conversion of high-sulfur coals into nonpolluting fuel oil is being developed at the Pittsburgh Energy Research Center (formerly in the Buereau of Mines) of the Energy Research and Development Administration. In this process, coal conveyed in process-derived recycle oil is propelled by a turbulent flow of hydrogen through a fixed bed of Co-Mo catalyst pellets at 425 to 450°C and 2,000 to 4,000 psi. The combined effect of the hydrogen, turbulence, and catalyst is to liquefy the coal in high yields at high throughput and to desulfurize it. Sulfur is eliminated as H_2S which is easily converted into inert elemental sulfur for industry or storage. Extended operations in a 1/2 TPD process development unit with various coals have demonstrated the broad applicability of the process. Typically, from a Kentucky hvAb coal containing 5.5% S and 16.5% ash, the centrifuged product oil produced at 4,000 psi and 450°C had 0.2% S and 0.5% ash; at 2,000 psi and 450°C the oil produced was heavier and higher in sulfur and ash--0.5% and 1.5%, respectively. The design and construction of a 10 TPD process development unit is in progress. Industrial firms are participating in this program and will also participate in the program for the proposed SYNTHOIL demonstration plant. (auth)

8212 **Coal gasification.** Akhtar, S. pp vp of In Second annual symposium on coal gasification, liquefaction, and utilization: best prospects for commercialization. Pittsburgh; Univ. of Pittsburgh (1975).

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

See CONF-750868—.

This paper consists solely of diagrams and tables showing a continuous unit for converting lignite to oil, the effect of pressure, time, and temperature on the production of oil, the results of the liquefaction of North Dakota lignite, and properties of the oil produced. (EJH)

8213 **Comparison of liquefaction processes.** Chun, S.W. (Pittsburgh Energy Research Center). pp vp of In Second annual symposium on coal gasification, liquefaction, and utilization: best prospects for commercialization. Pittsburgh; Univ. of Pittsburgh (1975).

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

See CONF-750868—.

The principles of some of the coal liquefaction processes currently under development are summarized. General descriptions of the processes as well as the product distributions are given. The purpose is to acquaint the newcomers to the area of coal liquefaction with the basic principles of coal liquefaction and also to point out the technical areas where more R and D effort is needed. This presentation is not intended to list all the coal liquefaction R and D projects that are under investigation nor is it intended for direct comparison for the purpose of weighing one process against another on either a technical or an economic basis. The paper as presented in this publication consists solely of tables and diagrams. (auth)

8214 **Overview of R and D on coal liquefaction.** Yavorsky, P.M. (Pittsburgh Energy Research Center). pp vp of In Second annual symposium on coal gasification, liquefaction, and utilization: best prospects for commercialization. Pittsburgh; Univ. of Pittsburgh (1975).

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

See CONF-750868—.

Various methods of coal liquefaction are described briefly. In general, the methods described are: direct catalytic hydrogenation, solvent extraction, pyrolysis, and indirect variations. Flowsheets for several of the processes are included. (EJH)

8215 **Coal liquefaction process.** Urban, P. (to Universal Oil Products Co.). US Patent 3,909,390. 30 Sep 1975. Filed date 29 Jul 1974. 24p.

A process is described for producing hydrocarbonaceous products from coal, which includes contacting coal with water, a reducing gas and a catalytic sulfur compound, separating the liquefied coal phase from an aqueous phase, contacting the liquefied coal phase with water to remove ash, extracting the resulting low ash coal liquids with an aromatic hydrocarbon solvent to recover a first, ash-free, hydrocarbonaceous product, and further extracting the raffinate from the aromatic extraction operation with a solvent mixture of a polar hydrocarbonaceous solvent and an aromatic solvent to recover a second, ash-free hydrocarbonaceous solvent. (auth)

8216 **Coal to reactor feeder for coal liquidification.** Peterson, W.D. II. US Patent 3,910,428. 7 Oct 1975. Filed date 15 Nov 1973. 4p.

A solid material feeding system is described for having controlled feeding of a granulated solid material from a hopper to a reactor and mixing with the solid material a gas which reacts with the solid in the reactor, the gas also cleaning the feeder, promoting a continuous flow without material plugging and hangup; the feeder atmosphere being high-pressure hydrogen, the feeder drive shaft being sealed from the atmosphere by a sealing system of high-pressure hydrogen over liquid via a low-pressure seal, the high-pressure liquid over atmosphere via a high-pressure seal, the liquid being cooled as required. (auth)

8217 **Coal dissolving process.** Seitzer, W.H.; Shinn, R.W. (to Sun Research and Development Co.). US Patent 3,920,536. 18 Nov 1975. Filed date 15 Jan 1973. 6p.

A process for dissolving subbituminous coal by heating coal in the presence of a hydrogen-donor oil, gaseous carbon monoxide, water, hydrogen, and an ammonium or alkali metal molybdate at a temperature of from about 400 to about 425°C and at a total pressure of from about 2000 to about 5000 psig is described. (auth)

PYROLYSIS AND CRACKING

REFER ALSO TO CITATION(S) 8150

8218 (ERDA—114-75/1, pp 35-37) **Chemicals from coal.** (Dow Chemical Co., Midland, MI). 1975.

In Coal liquefaction. Quarterly report, January—March 1975.

During the quarter, the U.S. Bureau of Mines furnished a sample of Synthoil coal oil produced in its Bruceton, Pennsylvania, pilot plant. Petrochemical processing experiments (straight-run distillation, hydrocracking, and steam coil cracking) and data interpretation continued on COED syncrude and H-Coal oil. The COED syncrude straight-run mid-distillate (the portion that distills between 350 and 650°F) was submitted to catalytic hydrocracking and steam coil cracking. The resultant product was further hydrocracked and steam coil cracked. Trace metal analyses of iron, nickel, lead, and nine other metals were reported for the straight-run products, with concentrations lying near or below the detection level of the instrument (usually less than 0.5 ppM). Initial straight-run distillations, that is, without steam coils or added hydrogen, of the H-Coal oil were completed along with steam coil cracking of the straight-run mid-distillate and further hydrocracking of the resultant product were completed. (auth)

SOLVENT EXTRACTION

REFER ALSO TO CITATION(S) 8137, 8169, 8201, 8214

8219 (ERDA—114-75/1, pp 11-14) **Solvent-refined coal (SRC) process.** (Pittsburgh and Midway Coal Mining Co., Merriam, KS). 1975.

In Coal liquefaction. Quarterly report, January—March 1975.

During the first quarter of 1975, operation of the SRC pilot plant continued. Problems experienced with the mineral residue dryer were solved, and the filtration area of the plant was revised to improve the operability of the filters. A material balance run was conducted to determine overall process yields; a positive net yield of solvent was obtained and the recovery of all elements from the feed coal was good. Laboratory research by P and M included experiments using the two-dissolver/reactor configuration to study filtration rates, solvent recycling, decreased slurry residence time, increased concentration of coal in the slurry, and temperature variations. Oklahoma State University conducted experiments to test the capability of various catalysts to remove sulfur and nitrogen from coal liquids; results indicated that Nalcomo 474 catalyst, tested previously, was preferred. At Washington State University, research on gasification of coal mineral residue from the pilot plant showed that no recovery of elemental iron from the residue was obtained under the conditions investigated. (auth)

BY-PRODUCTS

REFER ALSO TO CITATION(S) 8129, 8218, 8238, 8368, 8370, 8371

8220 (ERDA-tr—108) ***Patent claims.*** 1975. Translated from German Patent 2,438,252. 4p. Dep. NTIS $3.50.

The patent claims for a method which catalytically converts a feed containing aliphatic oxygen-containing organic compounds into a product containing aromatic compounds and their derivatives are given. The reactions occur at a temperature of at least 260°C and a pressure of 0 to 211 atm on a catalyst containing an aluminosilicate zeolite. (JSR)

PROPERTIES

REFER ALSO TO CITATION(S) 8120, 8200, 8246

8221 (BERC—0020-1) **Mass spectrometric analytical services and research activities to support coal-liquid characterization research. Quarterly report, June 9, 1975—September 9, 1975.** Scheppele, S.E. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry). 28 Aug 1975. Contract E(34-1)-0020. 6p. Dep. NTIS $3.50.

A Perkin-Elmer 3920 gas chromatograph and associated software has been ordered. The materials necessary to interface it to the CEC 21-110B mass spectrometer and the other auxiliary components of the total GC/MS system are being acquired. Elemental composition data were obtained from 35 coal-liquid samples from the mass spectra of each sample recorded at high resolution on photographic plates. (auth)

8222 (CONF-750755—) **NSF workshop on the fundamental organic chemistry of coal, Knoxville, Tennessee, July 17—19, 1975.** Larsen, J.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1975. 306p. National Science Foundation, Washington, DC.

From NSF workshop on the fundamental organic chemistry of coal; Knoxville, Tennessee, United States of America "USA" (17 Jul 1975).

Fourteen papers were presented at this conference. Thirteen of the papers were included in the proceedings; an additional paper was issued separately with an addendum to bring it up to date at the time of the meeting. Three of the papers were from ERDA sites, and an abstract for ERA was prepared for each of them. (EJH)

8223 (CONF-750755—, pp 58) **Coal structure and reactivity.** Morrey, J.R.; Tingey, G.L. (Battelle Pacific Northwest Labs., Richland, WA). 1975.

From NSF workshop on the fundamental organic chemistry of coal; Knoxville, Tennessee, United States of America "USA" (17 Jul 1975).

In NSF workshop on the fundamental organic chemistry of coal, Knoxville, Tennessee, July 17—19, 1975.

A selective review of the literature is presented in order to determine the research areas in coal chemistry that require additional study, because a more thorough basic understanding of coal structure and reactivity will be essential as the requirements for utilization of coal increase and processes become more complex. The paper is divided into four major sections: Introduction, Structure, Reactivity, and Conclusions. (EJH)

8224 (CONF-750755—, pp 59-79) **Spectrometric investigations of coal.** Retcofsky, H.L. (Pittsburgh Energy Research Center). 1975.

From NSF workshop on the fundamental organic chemistry of coal; Knoxville, Tennessee, United States of America "USA" (17 Jul 1975).

In NSF workshop on the fundamental organic chemistry of coal, Knoxville, Tennessee, July 17—19, 1975.

Studies of coal structure by the complementary use of infrared (ir) and high-resolution nuclear magnetic resonance (nmr) spectrometry were carried out. The six coals selected for investigation represented the following ranks: subbituminous A, high-volatile A bituminous, medium-volatile bituminous, and low-volatile bituminous. Pyridine and CS_2 extracts of the whole coals were prepared for the nmr studies. Examination of the CS_2 extracts by proton and ^{13}C nmr yielded quantitatively the distribution of C and H atoms among various organic structures in each of the extracts. Estimates of the degree of aromatic ring substitution and the size of the polynuclear condensed aromatic ring structures were made on the basis of the nmr results. The excellent agreement between carbon aromaticities (f/sub a/ = C/sub ar//C/sub total/) estimated from proton data and those determined unambiguously by ^{13}C nmr strongly indicate that f/sub a/ values deduced from proton spectra can be realistically used in coal studies when ^{13}C data are unavailable. Proton data alone were used to deduce structural information for the pyridine extracts; the appearance of solvent resonances have thus far precluded the successful examination of pyridine extracts of coal by ^{13}C nmr. Infrared spectra of each of the solvent extracts as well as each of the whole coals were also obtained. Attempts to correlate the nmrand ir studies in order to deduce chemical structure information for whole coals were only partially successful. (auth)

8225 (CONF-750755—, pp 105-123) **Chromatographic and NMR analysis of coal liquefaction products.** Schweighardt, F.K.; Reteofsky, H.L.; Friedel, R.A. (Pittsburgh Energy Research Center). 1975.

From NSF workshop on the fundamental organic chemistry of coal; Knoxville, Tennessee, United States of America "USA" (17 Jul 1975).

In NSF workshop on the fundamental organic chemistry of coal, Knoxville, Tennessee, July 17—19, 1975.

An efficient chromatographic separation scheme has been developed to characterize the SYNTHOIL hydrodesulphurization coal liquefaction product. Chromatographic fractions were analyzed by nuclear magnetic resonance to determine carbon and hydrogen aromatic/aliphatic distribution ratios of major molecular types. The SYNTHOIL product and its coal-derived asphaltenes were found to contain intermolecularly hydrogen bonded complexes that may affect the physical properties of the oil. (auth)

8226 (CONF-760402—1) **Chemical-biological characterization of coal conversion liquids.** Clark, B.R.; Rubin, I.B.; Ho, C.H.; Guerin, M.R.; Epler, J.L. (Oak Ridge National Lab., Tenn. (USA)). 1976. 10p. Dep. NTIS $3.50.

From 81. national meeting of the American Institute of Chemical Engineers; Kansas City, Missouri, United States of America "USA" (11 Apr 1976).

Product liquids and organic concentrates obtained from aqueous effluents are chemically fractionated and analyzed chromatographically. Fractions are subjected to biological testing to

determine their toxic and mutagenic potentials; those fractions found to be active are further analyzed in order to focus on specific compounds which may produce the biological activity. Analytical techniques include GLC chromatography with sulfur and nitrogen selective detectors; chemical identifications are made from cochromatographic and GC-MS data. Some mutagenicity test results for various fractions of COED product oil are presented. (auth)

8227 (FE—2035-1) **Enthalpy measurement of coal-derived liquids. Quarterly technical progress report, July—September 1975.** Kidnay, A.J.; Yesavage, V.F. (Colorado School of Mines, Golden (USA)). 15 Oct 1975. Contract E(49-18)-2035. 15p. Dep. NTIS $3.50.

On June 24, 1975, work was initiated on a 36-month contract for experimental enthalpy measurements on coal-derived liquids. The type of calorimeter to be utilized was selected and detailed design calculations on the calorimeter and its support equipment were initiated. Preliminary work on the correlation of enthalpies for petroleum oils and fractions was also started. (EJH)

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 8243, 8287

8228 (LA-UR—76-86) **Assessment and control of environmental contamination from trace elements in coal processing wastes.** Wewerka, E.M.; Williams, J.M.; Wanek, P.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-eng-36. 7p. (CONF-760208—1). Dep. NTIS $3.50.

From EPA-OEMI symposium; Washington, District of Columbia, United States of America "USA" (9 Feb 1976).

Environmental problems associated with discarded refuse from coal cleaning and processing are recognized, including waste-bank instability, acid drainage from disposal areas, and noxious emissions from burning wastes. EPA, and other organizations, support efforts to develop methods for controlling forms of environmental contamination. Attention has turned to the environmental hazards posed by the vast array of potentially harmful trace elements in coal refuse materials. It is established that many mineral components of coal wastes are released into the environment by oxidation and aqueous leaching during natural weathering, and it is likely that some mineral matter is volatilized by burning wastes. The fate of trace elements in weathering or burning wastes, however, is for the most part unknown. EPA, through an interagency agreement with ERDA, has begun a research program at ERDA's Los Alamos Scientific Laboratory to assess and define the magnitude of environmental problems from trace elements in coal processing wastes and to develop appropriate pollution-control measures where needed.

8229 **Dissolution of limestone in simulated slurries for removal of sulfur dioxide from stack gases.** Kim, Y.K.; Deming, M.E.; Hatfield, J.D. (Tennessee Valley Authority, Muscle Shoals, AL). *Environ. Sci. Technol.*; 9: No. 10, 949-952(Oct 1975).

Rate of dissolution of limestone in 1 percent aqueous slurries, such as those used for the removal of SO_2 from stack gases, is expressed by the equation $k = [1.92 + (325/d)](6.15 - pH)(1.4 - 0.08\ P/sub\ O_2/)\ exp\ (-1450/RT)$, where k = dissolution rate, percent of stone dissolved/min; d = particle diameter of stone, μm; pH = pH of the liquid phase; P/sub O_2/ = O_2 content, percent, of gas; R = gas constant, cal/(mol)(deg); and T = temperature, °K. The activation energy for the dissolution is 1450 cal/mol. The rate of dissolution was increased by decrease in the particle size of the stone, pH and O_2 content of the gas, and by a rise in temperature. The degree of utilization of the limestone to form sulfite or sulfate generally increased as the rate of dissolution increased. Addition of a weak, organic acid, such as benzoic acid, increased the rate of dissolution of the limestone about 10 percent. (auth)

8230 **Recovery of SO_2 from waste gas emissions.** Sherif, F.G.; Hayford, J.S.; Blanch, J.E. (to Stauffer Chemical Co.). US Patent 3,911,093. 7 Oct 1975. Filed date 5 Oct 1972. 16p.

A process is described for recovering sulfur values from gas emissions by absorbing SO_2 in an aqueous solution comprising a mixture of Na_2HPO_4 and NaH_2PO_4 at a pH between about 2.5 and about 5 at an absorption temperature between about 85 and 200°F, treating the phosphate solution containing absorbed SO_2 with H_2S to produce sulfur, separating the sulfur from the phosphate solution and recycling the phosphate solution to the absorber. Provision is made to remove sulfate, which builds up in phosphate absorbent, by crystallizing sulfate from a purge stream. The process is particularly useful in the field of pollution abatement for recovering SO_2 from the off-gas obtained from a Claus-type reactor system. (auth)

8231 **Method for reducing nitrogen oxides.** Kudo, T.; Manabe, T.; Yoshida, K.; Gejyo, T.; Seki, M. (to Hitachi, Ltd.). US Patent 3,914,390. 21 Oct 1975. Priority date 20 Sep 1972, Japan. 20p.

Catalysts for conversion of nitrogen oxides comprises a porous ceramic carrier, and 0.1 to 10 percent by weight of copper oxide in terms of copper metal, 0.1 to 20 percent by weight of lanthanum oxide in terms of lanthanum metal and 0.01 to 12 percent by weight of zirconium oxide in terms of zirconium metal, based on weight of the carrier, these oxides being supported on the carrier. The catalysts are brought in contact with a gas containing nitrogen oxides in the presence of ammonia and sulfur oxides, thereby decomposing and converting the nitrogen oxides. (auth)

8232 **Removal of sulfur dioxide and/or trioxide from gaseous effluents of fossil fuel operated power and steam plants.** Kunin, R. (to Rohm and Haas Co.). US Patent 3,916,025. 28 Oct 1975. Filed date 14 Mar 1973. 8p.

The removal of sulfur dioxide (SO_2) and/or sulfur trioxide (SO_3) from the gaseous effluents of fossil fuel burning steam and power plants using certain macroreticular, weak acid, cation exchange resins is described. The gaseous streams to be treated may be derived from other sources but the invention has particular utility and applicability in the control of pollution emanating from the SO_2 and SO_3 contained in the gaseous effluents of fossil fuel burning steam and power plants. (auth)

8233 **Method for the removal of sulfur dioxide from gas mixtures.** Cotter, R.J.; Keogh, M.J. (to Union Carbide Corp.). US Patent 3,917,469. 4 Nov 1975. Filed date 24 Jul 1974. 8p.

Sulfur dioxide can be removed from gas mixtures by adsorption on polymers containing pendant nitrogen containing moieties. (auth)

8234 **Removal of contaminants from gaseous streams.** Reed, R.S.; Glueck, A.R. (to Catalox Corp.). US Patent 3,917,797. 4 Nov 1975. Filed date 8 May 1974. 6p.

A method and apparatus are described for the continuous removal of contaminants, such as sulfur containing compounds, from a gaseous stream, such as stack gas, by the passage of a liquid salt through the stream. (auth)

8235 **Method for removing oxides of sulfur from sulfur bearing gas.** McGauley, P.J.; Dor, A.A. (to Hanna Mining Co.). US Patent 3,917,800. 4 Nov 1975. Filed date 5 Oct 1973. 12p.

Gases containing oxygen and sulfur are contacted with a solid sorbent material of ferrous sulfate, iron oxide, or combinations of both, to remove the sulfur from the gas by converting the sorbent to ferric sulfate. The ferric sulfate is decomposed at a low temperature to magnetite and sulfur dioxide in the presence of a reducing agent, and the magnetite is recycled for use as part or all of the solid sorbent in the process. (auth)

8236 **Sulfur oxide adsorption and recovery.** Torrence, S.L.; Walker, W.C. (to Westvaco Corp.). US Patent 3,917,799. 4 Nov 1975. Filed date 26 Feb 1973. 8p.

A process is described for removing sulfur oxides from gas streams whereby the sulfur oxides are adsorbed onto a carbonaceous adsorbent and recovering sulfur dioxide from the spent adsorbent by contacting the adsorbent with an oxide-reducing gas, i.e., hydrogen sulfide, whereby the adsorbed sulfur oxides having been adsorbed as sulfuric acid and sulfur trioxide are reduced. (auth)

8237 **SO_2 abatement.** Konopik, A.E.; Kusko, J.D. (to E. I. Du Pont de Nemours and Co.). US Patent 3,917,798. 4 Nov 1975. Filed date 24 Sep 1973. 4p.

The process for removing SO_2 from a gas stream with a sulfuric acid solution containing a peroxygen compound and feeding the withdrawn scrubbing solution to a sulfuric acid plant is improved if the withdrawn scrubbing solution is treated to remove any excess peroxygen compound prior to being fed to the acid plant. The excess peroxygen compound can be removed by heating to 100°-150°C and concentrating to 60-90 percent by weight H_2SO_4 to decompose any residual peroxygen compound present. (auth)

8238 **Method of treating coal refuse.** Pelczarski, E.A.; Karnavas, J.A.; La Rosa, P.J. (to Black Sivalls and Bryson, Inc.). US Patent 3,917,795. 4 Nov 1975. Filed date 13 Dec 1972. 8p.

A method is described for treating coal refuse containing pyrites and ash to produce usable products therefrom. The coal refuse is mixed with lime or limestone, formed into pellets and heated to form pellets containing calcium sulfide. The pellets are then reacted with carbon dioxide and water to form hydrogen sulfide and a calcium carbonate bonded coherent product which may be used for a variety of commercial purposes. The hydrogen sulfide produced in the reaction is converted to saleable elemental sulfur. (auth)

8239 Process for sulfur dioxide removal from combustion gases. Selmeczi, J.G. (to Dravo Corp.). US Patent 3,919,393. 11 Nov 1975. Filed date 8 Mar 1973. 6p.

An improved process is described for the removal of sulfur dioxide from gases resulting from combustion of sulfur-containing fuels such as coal, with the gases passed through a wet scrubber to which there is added an aqueous solution of calcium oxide containing 2-10 percent magnesium oxide. The effeciency of sulfur dioxide removal in the scrubber is increased and scaling reduced therein. (auth)

8240 Process for the removal of oxides of sulfur from a gaseous stream. Selmeczi, J.G. (to Dravo Corp.). US Patent 3,919,394. 11 Nov 1975. Filed date 14 May 1973. 10p.

The removal of oxides of sulfur from gaseous streams is increased by the addition of magnesium oxide or magnesium hydroxide to a calcium hydroxide scrubbing liquor in an amount sufficient to provide magnesium ions in the liquor, upon introduction to a scrubbing unit, of between 250 and 5000 parts per million. The controlled amount of magnesium ions results in a higher alkalinity of the scrubber liquor and, in addition to increasing the sulfur removal from the gaseous stream, reduces the formation of calcium salt scaling within the system. The pH of the liquor, prior to introduction into the scrubber, is adjusted to a pH of between 5.5 and 10.0, preferably by the addition of predetermined amounts of calcium hydroxide and magnesium hydroxide thereto. (auth)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8185, 8228, 8232, 8239, 8245, 9430

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 8142, 8241

MINING

REFER ALSO TO CITATION(S) 8819

8241 (IS-ICP—14) **Iowa coal research project. Second annual progress report, January 15, 1975—January 15, 1976.** (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). 1976. 43p. Dep. NTIS $4.00.

The Iowa Coal Research Project continues to make good progress toward its primary goals of demonstrating feasible and environmentally satisfactory methods of mining coal, restoring land to productive use, and cleaning coal to a satisfactory level. By June 30, 1977 mining operations shall be completed and land replaced at Demonstration Mine # 1 (mining 135,000 tons of coal and restoring 35 acres to productive use). Efforts on secondary goals shall provide valuable contributions such as a comprehensive economic appraisal and a mining law handbook. Iowa's deep coal reserves are estimated to be from 20 to 100 times as great as its reserves suitable for strip mining. (LTN)

8242 (JPRS—66866) **Investigating the effectiveness of artificial and natural ventilation of open-pit mines.** Nikitin, V.S. Translated from *Ugol;* 5: No. 1, (1972). 15p. NTIS.

An investigation of the effectiveness of artificial and natural ventilation systems of open-pit mines is reported. (auth)

8243 (NTIS/PS—75/112) **Coal mine waste. A bibliography with abstracts. Period covered by report: 1964—October 1974.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jan 1975. 97p. NTIS $25.00.

This bibliography contains 51 selected abstracts of research reports retrieved using the NTIS on-line search system, NTISearch. The topics cover all aspects of coal mining refuse and refuse dumps. (auth)

8244 (NTIS/PS—75/714) **Acid mine drainage. A bibliography with abstracts. Search period covered: 1964—August 1975.** Brown, R.J. (National Technical Information Service, Springfield, Va. (USA)). Sep 1975. 201p. NTIS $25.00.

This bibliography, containing 150 abstracts, cites studies primarily concerning control and treatment methods. Also included are reports on hydrogeology, ecology, formation, and sources. (auth)

8245 (NTIS/PS—75/751) **Strip mining. A bibliography with abstracts. Search period covered: 1964—October 1975.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1975. 196p. NTIS $25.00.

This bibliography contains 145 abstracts pertaining primarily to environmental impacts, land reclamation, and satellite remote sensing of mines. A few abstracts deal with mining equipment, legal factors, economics, and safety aspects of strip mining. (auth)

8246 High-explosive fracturing studies in coal. Hearst, J.R. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* **22**: 5-6(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 8119, 8122, 8163, 8164, 8207, 8823

8247 System for the safe handling of pulverized coal. Garbee, A.K.; Honaker, J.A.; Sexton, J.R. (to Armco Steel Corp.). US Patent 3,912,015. 14 Oct 1975. Filed date 17 Jun 1974. 10p.

A system for the safe handling of pulverized coal includes conventional coal pulverizing and drying equipment, with cyclones and bag filters added, the latter serving to separate the fine coal from the conveying gas (usually air); and explosion suppression and fire suppression systems, both of which include conventional components. All three of these systems are so combined as to effect the grinding of raw coal whereby to dry and collect the pulverized coal in an oxygen containing atmosphere without property loss due to explosion or fire. Fire detectors, explosion detectors, and associated extinguishers are also strategically located throughout the system. Preferably the fire suppression system will go into actuation prior to the explosion suppression system and when this happens, the explosion suppression system may be shut down manually if the operator decides it will not be needed, whereby to avoid the expense of having to reload the explosion suppression system. (auth)

8248 Monorail support apparatus for a slurry transportation system. Jamison, W.B.; Coval, A.B. (to Consolidation Coal Co.). US Patent 3,920,039. 18 Nov 1975. Filed date 18 Apr 1974. 6p.

An underground slurry transportation system for a mine is made mobile by attaching a first and a second rail to the roof of a mine tunnel. The rails are parallelly spaced and each has the general cross sectional configuration of an I beam. The rails are attached to the roof by means of roof bolts. An adjustable coupling is provided so that the rails may be maintained fairly level in spite of the unevenness of the mine roof. A pair of slurry hoses is clamped together and supported in storage on the first rail and in active use on the second rail. The support system includes rollers on each of the rails which are attached to the clamps around the hoses. A conveyer is provided for transporting the hoses from the storage rail to the active rail. When the rail is required to make a 90° turn into another tunnel, a system is provided for maintaining orientation for the hose support system during the 90° turn. (auth)

COMBUSTION

REFER ALSO TO CITATION(S) 8196, 8477

8249 (ANL/ES-CEN—1013) **Development program on pressurized fluidized-bed combustion. Quarterly report, July 1, 1975—September 30, 1975.** Vogel, G.J.; Cunningham, P.; Fischer, J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 48p. (FE—1780-2). Dep. NTIS $5.50.

A development program on pressurized fluidized-bed combustion is being carried out in a bench-scale pilot plant capable of operating at 10-atm pressure. The concept involves burning fuels such as coal in a fluidized bed of particulate lime additive that reacts with the sulfur compounds formed during combustion to reduce air pollution. Nitrogen oxide emissions are also reduced at the combustion temperatures used, which are lower than those used in a conventional coal combustor. The $CaSO_4$ produced in the combustor is regenerated to CaO that is recycled to the combustor for removal of sulfur compounds. Information is presented on the effects of coal and additive particle size on SO_2 and NO emissions, one-step regeneration of sulfated limestone, laboratory-scale experiments on the reaction of calcium sulfide with calcium sulfate, volatile constituents in the effluent gas from coal combustion, properties of a dolomite bed of a range of particle sizes and shapes at minimum fluidization, and the status of separation of the combustion system and regeneration system. (auth)

8250 (CONF-760402—4) **Application of the fluidized bed coal combustion system to the production of electric power and process heat.** Fraas, A.P. (Oak Ridge National Lab., Tenn. (USA)). 1976. 23p. Dep. NTIS $3.50.

From 81. national meeting of the American Institute of Chemical Engineers; Kansas City, Missouri, United States of America "USA" (11 Apr 1976).

Burning coal with limestone in a fluidized bed offers an intriguing means for burning lignite, high-sulfur coal, anthracite, or organic wastes. This process provides a high heat transfer coefficient and retains the bulk of the sulfur in the bed as $CaSO_4$. Particularly interesting applications under development at ORNL are for a closed cycle gas turbine for total energy systems in building complexes and for the furnace-boiler of a potassium vapor topping cycle for utilities. Both systems also show great promise for use in the process industries as a means of providing both electricity and clean process heat at any temperature up to approximately 820°C. Information developed in the course of recent ORNL work is applied to some proposed industrial applications requiring both electricity and high-temperature process heat. (auth)

8251 (FE—2201-2) **Develop a concept for fluidized bed combustion of consol char using closed-cycle gas turbine. Interim report for period ending January 23, 1976.** Norton, J. (Energy Resources Co., Inc., Cambridge, Mass. (USA)). Jan 1976. Contract E(49-18)-2201. 4p. Dep. NTIS $3.50.

During the past reporting period the models for the system's components have been developed, and the computer program designed to generate and evaluate possible process flow sheets has been written. The program is now being debugged. (auth)

8252 **Fluidised bed combustion.** Highley, J. (to Coal Industry (Patents) Ltd.). US Patent 3,910,235. 7 Oct 1975. Priority date 2 Mar 1973, United Kingdom of Great Britain and Northern Ireland (UK). 6p.

A method for burning a fuel involves the use of a fluidized combustion bed in which the fuel is burned and a fluidized heat transfer bed in which heat generated by the combustion bed is transferred to a heat exchange fluid. Hot material from the combustion bed is circulated to the heat transfer bed and returned to the combustion bed and to this end the heat transfer bed is located adjacent the combustion bed. The rate of the circulation determines the heat output and this rate can be varied by varying the fluidizing velocities in the two beds. Both beds are conveniently contained within one body and may be divided from each other by a division which allows the circulation referred to above. (auth)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 8167, 8191, 8820

8253 **Coal research role in energy self-sufficiency.** Poundstone, W.N. (Consolidation Coal Co., Pittsburgh). pp 339-347 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

8254 **Energy overview.** Huebler, J. (Inst. of Gas Tech., Chicago). pp 1-10 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Total U.S. and world energy consumption and production since 1850 are shown, the most significant trend being a world production growth slightly greater than that of the U.S. in the last 20 years. Total U.S. fossil fuel resources as of 12/31/73 are listed, and the lifetimes of these resources are depicted for annual growth rates of 2, 3, and 4%; the effects of imports and use of non-fossil sources on these lifetimes are also indicated. World fossil fuel resources, although 5 to 7 times those of the U.S., will be limited to a lifetime ending about 2040 to 2070 (same as U.S.) unless extended by substantial use of non-fossil sources. Rather extensive data on natural gas and petroleum demand, production, and use in the U.S. indicate the need for economic incentives, primarily higher wellhead prices. The present shortfalls can only be corrected by synthetic fuels, provided primarily from coal conversion plants; to provide the desired quantities of synthetic fuels and to increase the direct use of coal at a rate of 3%/yr would require doubling of coal production by 1985 and nearly tripling by 1990--this plus construction of the synthetic fuels plants. The cumulative investment required for the synthetic fuel plants and mines is projected to the year 2000; it shows annual investment rates of less than $5 billion initially and rising to only $10 to 15 billion later on. This is compared with an expected capital investment by the electric industry of $19 billion in 1974. (LMT)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 8183, 8247

PETROLEUM

REFER ALSO TO CITATION(S) 8227

RESERVES

REFER ALSO TO CITATION(S) 8828

EXPLORATION

8255 (NTIS/PS—75/540) **Offshore drilling. A bibliography with abstracts. Search period covered: 1964—June 1975.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, Va. (USA)). Jul 1975. 167p. NTIS $25.00.

Drilling procedures, equipment, environmental aspects, and legal implications involved in oceanic mineral resources recovery are investigated in these Government-sponsored research reports. (auth)

8256 **Uphole receiver for logging-while-drilling system.** Sexton, J.H.; Patton, B.J. (to Mobil Oil Corp.). US Patent 3,886,495. 27 May 1975. Filed date 10 Jul 1974. 14p.

In a system for logging-while-drilling, an improved uphole receiver correlates a signal representing a received acoustic signal with a reference signal derived from the received acoustic signal to produce a synchronously rectified signal whose polarity is representative of the phase states of the received acoustic signal. The synchronously rectified signal is applied to a first integrator, which is sampled at the end of each bit time interval. The synchronously rectified signal is also applied to a second integrator, which is sampled at the midpoint of each bit time interval. This sampled voltage represents the phase error in the bit clock pulses defining the bit time intervals. A synchronous inverter changes the polarity of the error signal so that the polarity is the same regardless of the direction of polarity change of the synchronously rectified signal during the integration period of the second integrator. The error signal is suppressed when there is no change in polarity in the synchronously rectified signal during the integration time of the second integrator. (auth)

8257 **Directional acoustic-velocity distribution in a petroleum reservoir.** Shuck, L.Z.; Frohne, K.H.; Rennick, G.E.; Evans, D.M. (Morgantown Energy Research Center, W. VA). *Soc. Pet. Eng. J.*; **15**: No. 3, 234-246(Jun 1975).

Experimental conditions, theoretical considerations, and results of a directional acoustic-velocity survey in the plane of formation of an oil reservoir in Pennsylvania are given. More than 60 blasting-cap acoustic sources were discharged opposite the Bradford Third sand in 10 different walls located within a 1,200- by 1,350-ft rectangular array of 41 wells. Each source was monitored simultaneously by 11 different hydrophones strategically located within the 41-well array. Both acoustic sources and sensors were located at the formation elevation, about 2,000 ft below the surface, so that the in-situ velocities determined were in the plane of the sandstone formation. Well-to-well acoustic velocities were calculated and are presented in tabular and graphical form. The velocity data were further analyzed statistically to yield over-all reservoir velocity trends. Results of the study show that the reservoir is acoustically heterogeneous, with local variations in P-wave velocity of as much as 20 percent. The over-all P-wave velocity trend for the reservoir was greater in the east-west direction than in the north-south direction by about 700 ft/sec. The mean acoustic velocity for all wells in all directions was 15,621 ft/sec. The acoustic-velocity distribution is also correlated to directional permeability data obtained by oriented core analyses. (auth)

8258 **Methods for locating subterranean petroleum-bearing deposits.** Foote, R.S. US Patent 3,919,547. 11 Nov 1975. Filed date 1 Nov 1973. 6p.

Disclosed are apparatus and methods for locating subterranean petroleum-bearing deposits by detecting the relative intensity of near-surface radiation of potassium-40. Areas of relative depletion of potassium-40 are plotted on a scale map to delineate the horizontal periphery of a petroleum deposit. (auth)

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 8255, 8281

8259 (BERC/TPR—75/1) **El Dorado Micellar-Polymer demonstration project.** Coffman, C.L. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Oct 1975. 445p. Dep. NTIS $10.60.

Progress made in the implementation of a project designed to determine the economic feasibility of improved oil recovery using micellar-polymer processes and to determine the associated benefits and problems of each system tested is reported. The project allows a side-by-side comparison of two distinct micellar-polymer processes in the same abandoned field so that the reservoir conditions for the two floods are as nearly alike as possible. Results are reported for test wells drilled to obtain reservoir data, field injectivity and interference tests, and performance predictions. Engineering operations are summarized. (JSR)

8260 **Wellbore safety valve.** Berry, H.J.; Lewis, D.W. (to Sun Oil Co.). US Patent 3,885,627. 27 May 1975. Filed date 1 Jun 1973. 10p.

A wellbore safety valve system includes a plug held by a retention spider, a plug seat separated from and located above the plug, and a controlled release section for separating the spider from the plug so that the plug can engage the plug seat. The controlled release section may be responsive to electrical energy from the surface, flow rate in the well, or acoustical energy. (auth)

8261 **Hydraulic fracturing method.** Cooke, C.E. Jr. (to Exxon Production Research Co.). US Patent 3,888,311. 10 Jun 1975. Filed date 1 Oct 1973. 10p.

A method of fracturing subterranean formations is described, which employs propping agent particles composed of resin-filled or fiber-reinforced cement pellets or resin-filled clinker. (auth)

8262 **Method and compositions for fracturing well formations.** Tiner, R.L.; Holtmyer, M.D.; King, B.J.; Gatlin, R.A. (to Halliburton Co.). US Patent 3,888,312. 10 Jun 1975. Filed date 29 Apr 1974. 10p.

A crosslinked aqueous gel useful for fracturing and placing propping agents within a subterranean formation is disclosed. The gel has a high viscosity in said formation and has pumping characteristics in turbulent flow similar to those of water. (auth)

8263 **Use of materials as waterflood additives.** Gale, W.W.; Ashcraft, T.L. Jr.; Saunders, R.K. (to Exxon Production Research Co.). US Patent 3,888,308. 10 Jun 1975. Filed date 2 Jan 1974. 16p.

One embodiment includes an oil recovery process, more particularly a secondary or tertiary type crude oil recovery process utilizing a drive fluid to move a displacing fluid through a subterranean formation wherein the displacing fluid displaces crude oil therefrom and is driven through the formation by means of the drive fluid. The crude oil recovery process is improved by utilizing as the drive fluid a thickened, transparent, aqueous solution of a water-soluble sulfated, polyethoxylated C_{10}-C_{18} primary alcohol or alkylated phenol. The displacing fluid is generally an aqueous surfactant solution, a miscible displacing medium or most preferably a microemulsion. In a further embodiment, the water-soluble, polyethoxylated C_{10}-C_{18} primary alcohol or alkylated phenol is employed as a mobility control agent in a waterflood thereby increasing the sweep efficiency thereof. (auth)

8264 **Spray shield for oil wells.** Edge, B.J.; Collins, L.O. US Patent 3,902,555. 2 Sep 1975. Filed date 25 Oct 1973. 6p.

A spray shield assembly was designed for use in conjunction with oil wells that require artificial lift apparatus. The shield assembly includes a split hollow bonnet member which carries a seal assembly with the seal assembly being supported in overlying relationship relative to a stuffing box on the oil well. The bonnet member is removably affixed to structure of the oil well in a position to admit a polished rod to be sealingly and reciprocatingly received within the bonnet member and axially through the seal assembly. The spray shield assembly is made of component parts which are joined together in a manner that enables its assembly to the wellhead without the necessity of dismantling any portion of the pumpjack and wellhead apparatus. (auth)

8265 **Treatment of wells.** Shaubhnessy, C.M.; Gruesbeck, C. Jr.; Looney, J.R.; Salathiel, W.N. (to Exxon Production Research Co.). US Patent 3,902,557. 2 Sep 1975. Filed date 25 Mar 1974. 14p.

A method of treating a subterranean formation surrounding a well wherein a solvent including a C_4 to C_{10} alkyl ether of polyglycol ether containing from 10 to 22 carbon atoms per molecule is injected into the formation is described. The solvent improves permeability to the formation adjacent the wellbore. The solvent may be used as a preflush or afterflush for, or in combination with, other treating agents; or it may be used as the sole essential treating agent. (auth)

8266 **Method for pumping paraffine-base crude oil.** Chapman, D.W. US Patent 3,908,763. 30 Sep 1975. Filed date 21 Feb 1974. 6p.

A method is described for inducing and maintaining the flow of paraffin-base oil in a well structure. The method comprises heating and maintaining the well structure at a temperature below the fracturing and melting temperature of the paraffin, within that range of temperature where the paraffin is dissolved and/or reabsorbed and carried, in fluid state by the oil and above that chill temperature where the paraffin in the oil solidifies and separates from the oil. (auth)

PROCESSING

8267 **Process for the production of bitumen or bitumen-containing mixtures with improved properties.** Frese, A.; Christofzik, H. (to Chemische Werke Huels Aktiengesellschaft). US Patent 3,839,190. 1 Oct 1974. Priority date 25 Oct 1969, German, Federal Republic of (F.R. Germany). 10p.

The softening point of bitumens having softening points of up to 120°C is raised without adversely affecting rupturing point and other properties by heating the bitumen at a temperature above the softening point of up to 150°C for up to 30 minutes with either sulfuric acid or a metal halide selected from the group consisting of $TiCl_4$, $AlCl_3$, $VOCl_3$, VCl_4 and $ZrCl_4$. (auth)

8268 **Vapor-liquid separator.** Hamblin, R.J.J. (to Universal Oil Products Co.). US Patent 3,873,283. 25 Mar 1975. Filed date 2 Jul 1973. 10p.

A high degree of separation of entrained liquids from a resulting vapor stream and of entrained gas from a resulting liquid stream is achieved in a spherical vapor-liquid separator containing ring-shaped liquid holding trays which promote horizontal liquid flow. A mixed-phase feed stream is discharged tangential to the separator's outer wall. Liquid then flows in a circular path to a downcomer on the opposite side of the separator leading to other ring-shaped trays below and finally accumulates in a lower section of the separator from which it is discharged. The resulting slow liquid flow allows entrained gas to escape and pass horizontally through ring-shaped coalescers, which form part of a vertical central vapor conduit rising through the center of each ring-shaped tray and which break down liquid containing foam. Vapors from the different trays and the bottom section of the separator pass upward through the vapor conduit to an outlet on an upper section of the separator. (auth)

8269 **Hydrogenated alkyl aromatics as petroleum distillate fuel cold flow improvers.** Feldman, N.; Ilnyckyj, S. (to Exxon Research and Engineering Co.). US Patent 3,883,318. 13 May 1975. Filed date 24 Aug 1972. 12p.

Hydrogenated alkyl aromatics are useful as petroleum oil additives such as wax crystal modifiers and cold flow improvers for petroleum oils, e.g. atmospheric distillate fuels, particularly when used in combination with ethylene backbone middle distillate pour point depressants such as branched polyethylene, copolymers of 4 to 30 molar proportions of ethylene with an unsaturated ester, e.g. vinyl acetate, or another olefin, etc. (auth)

8270 **Reforming with catalysts containing a Group VIA metal component and technetium as a promoter.** Hensley, A.L. Jr.; Nevitt, T.D. (to Standard Oil Co.). US Patent 3,893,908. 8 Jul 1975. Filed date 15 Mar 1974. 8p.

There is provided a process for the reforming of a petroleum hydrocarbon stream. The process comprises contacting the hydrocarbon stream in a reforming zone under suitable reforming conditions and in the presence of hydrogen with a catalyst comprising a component having hydrogenation-dehydrogenation activity and dehydrocyclization activity, a suitable support, and as a promoter, a small amount of technetium. The support may comprise alumina and the component having hydrogenation-dehydrogenation activity and dehydrocyclization activity may be a member selected from the group consisting of one or more metals

of Group VIA, compounds of one or more metals of Group VIA, and combinations thereof. The preferred Group VIA metal is chromium. The catalyst may comprise also a second member selected from the group consisting of an oxide of an alkali metal, an oxide of alkaline earth metal, and mixtures thereof. (auth)

8271 Process for producing light fuel oil. Nace, D.M. (to Mobil Oil Corp.). US Patent 3,896,024. 22 Jul 1975. Filed date 2 Apr 1974. 10p.

The production of light fuel oil by catalytic cracking is accomplished in a single riser conversion zone by cracking a recycle oil product of cracking initially in the riser with freshly regenerated catalyst under restricted severity conditions and a fresh gas oil feed is cracked with coke deactivated zeolite cracking catalyst in an upper portion of the riser under restricted severity conditions. (auth)

8272 Apparatus for hydrocarbon conversion. Boret, R.; Bronner, C.; Huin, R.; Vidal, A. (to Institut Francais de Petrole des Carburants et Lubrifiants). US Patent 3,909,208. 30 Sep 1975. Priority date 17 Dec 1971, France. 8p.

A catalytic reaction chamber of the radial flow type is claimed. It comprises an external distribution chamber, an annular zone for the catalyst bed, limited by two perforated walls and a central manifold including a screen of inverted truncated cone shape extending downwardly from the top of the catalytic zone. Optionally, the higher portion of the external perforated wall may have the shape of a truncated cone. (Offical Gazette)

8273 High pressure cracking furnace and system. Woebcke, H.N.; Gartside, R.J. (to Stone and Webster Engineering Corp.). US Patent 3,910,768. 7 Oct 1975. Filed date 6 Nov 1973. 8p.

A high-pressure furnace for cracking hydrocarbons to produce olefin is described. Long flame burners produce combustion gases to circulate through radiant and convection sections in a furnace under pressure to crack hydrocarbons. Flue gas from the furnace serves to produce high-pressure steam, provide coolant to quench cracked gas, preheat the hydrocarbon-steam feed and aid in driving a turbine-compressor assembly. (auth)

BY-PRODUCTS

REFER ALSO TO CITATION(S) 8351, 8367, 8368, 8370, 8371, 8874

8274 Method of removing organometallic compounds from liquid hydrocarbons. Zimmerman, A.A. (to Exxon Research and Engineering Co.). US Patent 3,893,913. 8 Jul 1975. Filed date 8 Apr 1974. 14p.

Organometallic compounds are separated from liquid hydrocarbons containing the same by contacting the liquid hydrocarbon with an activated charcoal having cupric chloride impregnated thereon. The contacting may be accomplished at any combination of temperature and pressure at which the hydrocarbon will remain liquid and at which all components used in the process will remain stable. The contacting may be accomplished in essentially any suitable fashion; however, contacting in a fixed bed of the activated charcoal is, generally, most convenient and effective. Impregnation of the activated charcoal is accomplished by contacting a suitable activated charcoal with a solution of the cupric chloride and thereafter at least partially drying the resulting mixture such that the solvent remaining therein is internally adsorbed in the activated charcoal pores. Generally, the presence of water in the impregnated activated carbon adsorbent will improve separation performance. This method of performance is particularly suited to the separation of organo lead compounds from gasoline. (auth)

8275 Method of removing organometallic compounds from liquid hydrocarbons. Zimmerman, A.A. (to Exxon Research and Engineering Co.). US Patent 3,893,912. 8 Jul 1975. Filed date 8 Apr 1974. 18p.

Organometallic compounds are separated from liquid hydrocarbons containing the same by contacting the liquid hydrocarbon first with a treating agent selected from the group consisting of silicon tetrachloride, cupric chloride, cupric bromide, iodine and iodine in combination with an acid and then with a suitable sorbent such as an activated charcoal. Both the initial and final contacting may be accomplished at any combination of temperature and pressure at which the hydrocarbon will remain liquid and at which all components used in the process will remain stable. Both the initial and final contacting may be accomplished in essentially any suitable fashion; however, the first treating agent will, generally, be used in combination with a suitable solvent and effecting the second contacting in a fixed bed of the sorbent is, generally, most convenient and effective. (auth)

8276 Production of low pour point gas oil and high octane number gasoline. Garwood, W.E. (to Mobil Oil Corp..). US Patent 3,893,906. 8 Jul 1975. Filed date 21 Mar 1974. 6p.

A process is described for the simultaneous dewaxing of high pour point gas oil and upgrading of an aromatic containing naphtha by contact of a mixture of the gas oil and naphtha with a high silica to alumina ratio synthetic aluminosilicate zeolite catalyst, which is derived from a zeolite which was synthesized with an organic cation, incorporating a hydrogenation dehydrogenation component, and a hydrogen atmosphere at about 500° to 1,000°F followed by distillation of the product in order to recover a lower pour point gas oil fraction and a higher octane gasoline fraction. (auth)

8277 Process for the production of gasoline. Rollmann, L.D.; Zahner, J.C. (to Mobil Oil Corp.). US Patent 3,902,870. 2 Sep 1975. Filed date 30 May 1974. 4p.

Reduction of bromine number of cracked gasolines by etherifying the iso-olefin content thereof with excess methanol is followed by the addition of a small amount of water to extract the excess methanol remaining after the etherification. The water-methanol phase can be conventionally resolved and the fractions thereof recycled. (auth)

8278 Fuel composition with increased octane number. Friberg, S.E.; Lundgren, L.E.G. (to Svenska Utvecklingsaktiebolaget). US Patent 3,902,869. 2 Sep 1975. Filed date 24 Aug 1973. 10p.

The field of art to which this invention pertains is hydrocarbon based liquid fuel compositions having increased octane number by the use of microemulsion technique. The new composition comprises a main part of a liquid hydrocarbon mixture, water in the form of a microemulsion, an emulsifier which makes possible the solubilization of the water in the hydrocarbon mixture and at least one water-soluble inorganic substance which has been dissolved in the water solubilized in the hydrocarbon mixture. (auth)

8279 Gasoline production. Kemp, J.D.; Sieg, R.P. (to Chevron Research Co.). US Patent 3,904,384. 9 Sep 1975. Filed date 13 Nov 1972. 10p.

A process for producing a high-octane gasoline having reduced smog-forming tendencies is described, which comprises: thermally dehydrogenating-cracking isobutane to obtain propylene and isobutene; hydrating propylene to obtain isopropanol; etherating the isopropanol with the isobutene to obtain t-butyl isopropyl ether; and blending the t-butyl isopropyl ether with gasoline-boiling-range hydrocarbons. Preferably the thermal dehydrogenation is carried out under conditions, specifically including a temperature between about 1125 and 1275°F., to produce a molar ratio of isobutene to propylene between 1.0 and 1.25. (auth)

8280 Hydrocarbon conversion process. Kozlowski, R.H.; Sieg, R.P.; Scott, J.W. (to Chevron Research Co.). US Patent 3,912,463. 14 Oct 1975. Filed date 25 Oct 1974. 10p.

A process is given for producing gasoline blending stock which comprises (a) feeding an alcohol and a light hydrocarbon mixture containing at least tertiary olefins, linear olefins and isobutane to an etheration zone, (b) reacting the alcohol with the tertiary olefins in the etheration zone to obtain an ether and unreacted linear olefins and isobutane, (c) separating the ether from the linear olefins and isobutane, (d) feeding water and at least the linear olefins to a hydration zone, (e) reacting water with at least a portion of the linear olefins in the hydration zone to obtain at least a secondary alcohol, (f) separating unreacted olefins and paraffins from the secondary alcohol, (g) feeding at least a portion of the unreacted olefins and paraffins to an alkylation plant for reaction to obtain an alkylate, and (h) blending at least portions of the ether, product alcohol and alkylate to produce a gasoline blending stock. (Official Gazette)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 8260

8281 Subsurface tubing safety valve with auxiliary operating means. Crowe, T.L. (to Baker Oil Tools, Inc.). US Patent 3,896,876. 29 Jul 1975. Filed date 12 Sep 1974. 18p.

A subsurface tubing safety valve for wells is described in which a sleeve is held in a first position and shiftable to a second position by a shifting tool. The safety valve is held open by control fluid pressure supplied from the top of the well and is closeable by well fluid pressure when control fluid pressure is reduced. When the shiftable sleeve is moved to its second position, it also opens the safety valve and forms a seat for an auxiliary wireline safety valve adapted to be held open by control fluid pressure and closed by well fluid pressure. (auth)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 8832

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8285

8282 (NTIS/PS—75/118) **Biological effects of oil spills. A bibliography with abstracts. Search period covered: 1964—October 1974.** Lehmann, E.J. (National Technical Information Service, Springfield, Va. (USA)). Jan 1975. 158p. NTIS $25.00.

All aspects of the biological and ecological effects of oil spills in salt and fresh waters are presented in 107 abstracts. The effects on microorganisms, plants, and animals are studied along with research on the residues and metabolic products of various oil components. (auth)

8283 (NTIS/PS—75/152) **Biodeterioration of oil spills. A bibliography with abstracts. Period covered by report: 1964—October 1974.** Lehmann, E.J. (National Technical Information Service, Springfield, Va. (USA)). Jan 1975. 127p. NTIS $25.00.

The degradation of spilled oil by microorganisms is covered. The 81 abstracts include studies on the microbiology, beach cleanup, oil spill removal, and the degradation products. (auth)

8284 (NTIS/PS—75/595) **Oil pollution detection and sensing. A bibliography with abstracts. Search period covered: 1964—July 1975.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jul 1975. 227p. NTIS $25.00.

Research on oil and hydrocarbon detection, sampling, and monitoring methods and instrumentation are cited. Included are techniques related to chromatography, infrared spectroscopy, light scattering, fluorescence, mass spectroscopy and remote sensing. The majority of abstracts deal with oil spills, however, abstracts on oil detection in industrial wastes and sewage are included. (Contains 176 abstracts). (auth)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 8760, 8826, 8829, 8830, 8863

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 8827

8285 (NTIS/PS—75/510) **Supertankers and superports. A bibliography with abstracts. Search period covered: 1964—June 1975.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, Va. (USA)). Jun 1975. 132p. NTIS $25.00.

Construction and operation of supertankers and the requirements for port facilities are reviewed in these Government-sponsored research reports. The environmental aspects are investigated. (auth)

PROPERTIES

8286 (BERC/RI—76/3) **Waste lubricating oil research: characterization of basestocks from used lubricating oils. Part 3.** Whisman, M.L.; Cotton, F.O.; Goetzinger, J.W.; Reynolds, J.W. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Feb 1976. 19p. Dep. NTIS $3.50.

Physical and chemical data derived from the analysis of 10 used oils are presented in this report, the third of a four-part investigation. The 10 used lubricating oils of this report were obtained from widely divergent areas of the continental United States, and represent typical re-refinery feedstock. Collection areas ranged from the State of Washington to Florida and from southern California to Pennsylvania. A better understanding of the compound types and distribution of major structural groups in waste crankcase oils is required to make a judgment regarding the possibility and probability of producing consistent product from a given re-refinery. Identification of contaminants inherent to waste crankcase oils is pertinent to selecting proper re-refining technology even though contaminants have little or no bearing upon the final quality of product if properly and effectively removed during processing. The significant measure of product consistency lies in the composition of the petroleum base of these used oils; therefore, this investigation was directed toward the qualitative and semiquantitative measurement of compound types found in waste oils. (auth)

NATURAL GAS

EXPLORATION

REFER ALSO TO CITATION(S) 8255

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 8255, 8262, 8265, 8281

BY-PRODUCTS

REFER ALSO TO CITATION(S) 8180

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 8281

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 8833, 8834

WASTE MANAGEMENT

8287 **Method of reducing the concentration of nitrogen oxides in a gaseous effluent from a thermal plant.** Sigal, I.Y.; Naidenov, G.F.; Nizhnik, S.S.; Gurevich, N.A. US Patent 3,918,834. 11 Nov 1975. Filed date 9 Aug 1973. 4p.

A method is described of reducing the concentration of nitrogen oxides in a gaseous effluent from a thermal plant fitted with burners. The fuel is burned in two stages under the conditions of oxygen deficiency in a high-temperature zone. The two-stage combustion is accomplished by redistributing the flows of fuel and air inside the burners so that some air mixed with fuel is introduced in a spiral flow at periphery of the passages through the burners, and the rest of the air required for complete combustion of the fuel is introduced in a straight-line flow directed along the axis of the burners. (auth)

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 9430

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 8829, 8833, 8863

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 8831

PROPERTIES

8288 (BM-IC—8684) **Analyses of natural gases, 1974.** Moore, B.J. (Bureau of Mines, Amarillo, Tex. (USA)). 1974. 125p. GPO $1.90.

Tabulations are presented of the results of chemical analyses of 352 natural gas samples from wells and pipelines in 18 states and 5 foreign countries. All of the samples were obtained and analyzed during the calendar year 1974. (JSR)

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 8776, 8778, 8779

DRILLING, FRACTURING, AND MINING

REFER ALSO TO CITATION(S) 8289

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 8199

8289 (NP—20778) **Modified in-situ oil shale plant 50,000 bbl/CD capacity.** (TRW Systems, Redondo Beach, Calif. (USA)). 27 Jun 1974. Contract 1401-0001-1864. 135p. TIC.

Methods to be used in constructing and operating a modified in-situ oil shale processing plant producing approximately 50,000 barrels per calendar day of upgraded crude oil are described. Also provided are the projected economics of such a business enterprise, for 18 gal/ton and 25 gal/ton ore, for product prices of $8.35 and $12.35 per barrel. The modified in-situ method proposed consists of conventional room and pillar mining of a grid work of drifts and crosscuts at the upper and lower levels of a 450 ft thick shale deposit, removing sufficient material that subsequent explosive fracturing of the ore between upper and lower drifts will provide a rubble of 20 percent void fraction. Pillars are left standing to support 1300 ft of overburden to minimize compaction and reduction of permeability of the rubble during subsequent retorting. The mined-out material is retorted in surface retorts, and provides 27 percent of the plant output. The rubble remaining in the mine is fired at the top level with compressed air and natural gas. After the shale ignites, the natural gas is turned off, and the compressed air flow is maintained for one year, utilizing the carbon deposited on the retorted shale to maintain combustion. The hot gases from the burning zone pyrolize the kerogen in the shale below that zone producing gases and an oil mist, which are removed from trenches in the bottom drifts, and treated on the surface. It is emphasized that the operation described has never before been accomplished, in respect to the particular combination of the height of the in-situ retort (450 ft), the ore assay (18 gals/ton), and the depth of overburden (1300 ft). (auth, abstract modified)

8290 **In situ production of bitumen from oil shale.** Pelofsky, A.H. (to Cities Service Research and Development Co.). US Patent 3,882,941. 13 May 1975. Filed date 17 Dec 1973. 6p.

Hydrocarbons are recovered from oil shale deposits by introducing hot fluids into the deposits through wells and then shutting in the wells to allow kerogen in the deposits to be converted to bitumen, which is then recovered through the wells after an extended period of soaking. Heat energy is introduced in quantities sufficient to heat the deposit in the vicinity of the wells to more than 50°F (Fahrenheit Degrees) above its transition temperature (the temperature at which exfoliation of the shale structure commences). Introduction of heat energy to a shale deposit can be by any suitable means with use of hot fluids at temperatures between about 700° and about 2,000°F being preferred. Preferred fluids include steam and hot water, although other fluids not containing free oxygen, such as liquid or vaporous hydrocarbons, flue gas, etc. may be used. (JGB)

8291 **Outlook and status of in-situ oil shale research.** Decora, A.W. (Energy Research and Development Administration, Laramie, WY). *Trans. Am. Nucl. Soc.*; **22**: 1(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

8292 **In-situ oil shale processing research in the Rock Springs, Wyoming area.** Carpenter, H.C. (Energy Research and Development Administration, Laramie, WY). *Trans. Am. Nucl. Soc.*; **22**: 1-2(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

SURFACE METHODS

REFER ALSO TO CITATION(S) 8148

8293 **Process for production of hydrocarbon liquids and gases from oil shale.** Linden, H.R.; Tarman, P.B.; Feldkirchner, H.L. (to American Gas Association). US Patent 3,922,215. 25 Nov 1975. Filed date 1 Jun 1973. 12p.

A process for the production of hydrocarbon liquids and gases from oil shale is described. It includes the steps of gradually preheating oil shale in a preheat and prehydrogenation zone to a temperature of about 700° to about 950°F in the presence of hydrogen-rich gas without substantial production of liquid and gas in the preheat and prehydrogenation zone, then destructively distilling the preheated and prehydrogenated oil shale in a hydroretort zone at a temperature of about 850° to about 1,250°F in the presence of hydrogen-rich gas to form aliphatic and alicyclic hydrocarbon liquids and low molecular weight paraffinic hydrocarbon gases from the preheated and prehydrogenated organic hydrocarbon portion of the oil shale. The hydrogen-rich gas may be passed countercurrent in thermal exchange relation to the spent shale to recover heat from the spent shale heating the hydrogen-rich gas for passage countercurrent and in thermal exchange relation to fresh oil shale in the preheat and prehydrogenation zone. The improvement of this process lies in the exceptionally high conversion of the organic component of oil shale to products of high value including high yields of readily distillable liquids comprising a high proportion of aliphatic and alicyclic hydrocarbon liquids and to low molecular weight paraffinic hydrocarbon gases. The process can be controlled, if desired, to maximize production of aliphatic and alicyclic hydrocarbon liquids. The liquids produced may be utilized for a wide variety of purposes including gasification for the production of synthetic pipeline-quality gas from oil shale. (auth)

BY-PRODUCTS

REFER ALSO TO CITATION(S) 8220, 8370, 8371

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8116

8294 (PB—238655) **Trace pollutant emissions from the processing of metallic ores. Environmental protection technology series (final).** Katari, V.; Isaacs, G.; Devitt, T.W. (PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio (USA)). Oct 1974. Contract EPA-68-02-1321. 282p. NTIS $8.75.

The report gives results of a study of eight metallic ore processing industries. Selected for their potential for hazardous pollutant emissions, the industries were: iron and steel, ferroalloy, primary copper, primary lead, primary zinc, aluminum, titanium, and uranium. Bases for selection were: quantity of ore processed, toxicity of potential emissions, fugitive dust emissions potential, and process characteristics. The report describes the processes in each industry in terms of a functional process statement, process operating conditions, energy requirements, potential emissions, and method of transferring material from one process to the next. Eleven processes are recommended for more detailed study because of their significant hazardous pollutant emissions potential. (GRA)

8295 (ORNL-tr—2995) **Characteristics of the toxic action of propyl phenol isomers and their safe levels in water bodies.** Veldre, I.A.; Norman, Kh.K.; Saliev, V.P. Translated by Martha Gerrard from *Gig. Sanit.*; No. 7, 94-96(1974). 5p. Dep. NTIS $4.00.

Threshold concentrations (perception threshold) of propyl phenol isomers for organoleptic properties that are noxious are: OPP, 0.01 mg/liter for odor, odor in heating, and chlorination; PPP, 0.025 mg/liter for odor, taste in heating, and chlorination. Threshold concentrations of propyl phenol isomers according to the effect on public health regimes of reservoirs may be taken as 1 mg/liter. The combined evaluation of the results of experiments suggests that the limiting index of noxious properties of propyl phenol isomers is the organoleptic one. The concentrations of both isomers (OPP and PPP) should be limited to 0.01 mg/liter in reservoirs. (auth)

FISSION FUELS

RESERVES

8296 (ERDA-tr—90) **Production of concentrates for supplying a national nuclear electric program.** Delgado, C.M. (Instituto Nacional de Energia Nuclear, Mexico City). Jul 1975. Translated from Conference on nuclear electric energy and applications in Latin America. (CONF-750752—1). 25p. Dep. NTIS $4.50.

From Conference on nuclear electric energy and applications in Latin America; Mexico City, Mexico (Jul 1975).

An analysis was made of the yearly requirements of natural U to satisfy a nuclear power program in Mexico. On the basis of these requirements an evaluation was made of the concentrate production necessary to supply those needs. The lack of known commercial reserves to satisfy the concentrate needs is shown. An estimation is made of the costs for the discovery and exploitation of sufficient reserves. In evaluating the U needs and associated costs, three cases were considered: all BWR or PWR or HWR. (JSR)

8297 (PB—239515) **Uranium resources to meet long term uranium requirements. Special report.** (Electric Power Research Inst., Palo Alto, Calif. (USA)). Nov 1974. 123p. (EPRI-SR—5). NTIS $5.25.

Comparison between uranium requirements and uranium resources, the uncertainty concerning the size of the nation's uranium resources, and the future levels of uranium consumption are discussed. Published AEC uranium statistics form the basis for all of the quantitative uranium resource analysis. The United States is essentially unexplored for uranium and much more information is necessary to adequately assess the uranium potential of the country. (GRA)

8298 (TID—3357) **Nuclear raw materials: a selected bibliography.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jan 1976. 48p. Dep. NTIS $4.00.

The bibliography contains 273 citations of reports placed on open file for examination at ERDA's Grand Junction Office. These citations cover reserves, exploration, and feed processing, but exclude logs of government drill holes, maps, and cross sections. (LK)

8299 **Current uranium supply picture.** Nininger, R.D. (Energy Research and Development Administration, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **21**: No. 2, Suppl., 29(1975).

From Nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975).

See CONF-750928—.

EXPLORATION

REFER ALSO TO CITATION(S) 8296, 8298

8300 (GJO—1640) **Vein-type uranium deposits.** Rich, R.A.; Holland, H.D.; Petersen, U. (Harvard Univ., Cambridge, Mass. (USA). Dept. of Geological Sciences). 10 Oct 1975. Contract AT(05-1)-1640. 383p. Dep. NTIS $10.75.

A critical review is presented of published data bearing on the mineralogy, paragenesis, geochemistry, and origin of veiw-type uranium deposits. Its aim is to serve as a starting point for new research and as a basis for the development of new exploration strategies. During the formation of both vein and sandstone types of deposits uranium seems to have been dissolved by and transported in rather oxidized solutions, and deposited where these solutions encountered reducing agents such as carbon, sulfides, ferrous minerals and hydrocarbons. Granitic rocks abnormally enriched in uranium have apparently been the most common source for uranium in vein-type deposits. Oxidizing solutions have been derived either from the surface or from depth. Surface solutions saturated with atmospheric oxygen have frequently passed through red bed or clean sandstone conduits on their way to and from uranium source rocks. Deep solutions of non-surface origin have apparently become sufficiently oxidizing by passage through and equilibration with red beds. The common association of clean sandstones or red beds with uranium-rich granites in the vicinity of vein-type uranium deposits is probably not fortuitous, and areas where these rock types are found together are considered particularly favorable targets for uranium exploration. (auth)

FEED PROCESSING

REFER ALSO TO CITATION(S) 8296, 8298

ENRICHMENT

GASEOUS DIFFUSION

8301 (K—1839(Pt.5)) **Behavior of the minor uranium isotopes in separation cascades. Part V: review and appraisal.** Blumkin, S.; Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 19 Jan 1976. Contract W-7405-eng-26. 35p. Dep. NTIS $5.00.

Part V is the final chapter of the completion report for this study. The results of the calculations made to determine the behavior of the minor uranium isotopes (^{234}U and ^{236}U) in separation cascades and the results of the two plant tests made to substantiate the validity of the calculations are reviewed briefly. Based on the fact that the ^{234}U and ^{236}U concentrations relative to that of ^{235}U in cascade withdrawal streams reflect the cascade flowsheet, it was concluded that the use of the minor isotope concentration measurements in cascade withdrawal streams, which is usually referred to by the acronym, MIST, is a potentially valuable adjunct to material accounting for safeguarding a ^{235}U enrichment cascade. A characteristic of MIST which qualifies it particularly for safeguards application under the NPT is the fact that its use is entirely non-intrusive with regard to process technology and proprietary information. The usefulness of MIST and how it may be applied are discussed briefly. To conclude this appraisal of MIST an enumeration is made of the capabilities that a safeguards inspection team would have to possess in order to apply MIST. (auth)

LASER EXCITATION

REFER ALSO TO CITATION(S) 8336

8302 (UCRL-Trans—10965) **Procedure and device for separating particles such as the ^{235}U isotope of uranium from a plasma.** Janes, G.S. 1973. Translation of Belgian Patent No. 807,116. 20p. Dep. NTIS $3.50.

A process and a device for separating the particles of a plasma and, in particular, for collecting selectively ionized isotopes for isotope enrichment are described. A new technique for efficient enrichment of ^{235}U involves exposing uranium vapor to a pulsating laser beam, producing a plasma of selectively ionized ^{235}U atoms, thus permitting the separation of ^{235}U ions according to their electric charge. (LK)

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 9085, 9183

8303 (ORNL—5051) **Hot-pressing study on mixed uranium—plutonium nitride for advanced reactor fuel.** Chang, J.Y. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 66p. Dep. NTIS $5.50.

The hot-pressing characteristics of mixed (U,Pu)N for advanced reactor fuel were studied in order to provide a better insight into the densification process and thus improve fuel fabrication technique. A detailed experimental procedure for continuous measurement of densification and an analog computer circuit to simulate hot-pressing are presented. Mixed (U,Pu)N of 99 percent density was fabricated at 4000 psi and 1450°C, and 94 percent density was obtained with 3000 psi at 1450°C. A digital computer program for the densification process was also written to analyze and predict the density of the pellet at any given time or at different applied pressures than those actually tested. The time dependence of the temperature in the proposed equation to simulate the experimental heating period of the die was first introduced to improve the interpretation of experimental data. The best values of the hot-pressing coefficients were determined by curve fiting of the equation with experimental data. The values are given for mixed (U, Pu)N that had been fabricated with a starting density of 63 percent and a hot-pressing pressure of 3000 psi at 1450 +- 10°C. (auth)

8304 **Actinide redistribution due to pore migration in hypostoichiometric mixed-oxide fuel pins.** Guarro, S.; Olander, D.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *J. Nucl. Mater.;* **57**: No. 2, 136-144(Aug 1975).

Redistribution of plutonium due to migration of pores in hypostoichiometric mixed-oxide fuel is analyzed. The unequal volatilities of the oxides of uranium and plutonium cause changes in the Pu/U ratio in the solid ahead of and in the wake of a moving pore. These elementary redistribution events of single pores are then combined to determine the gross redistribution in the fuel. For typical LMFBR fuel operating conditions, calculated redistribution due to pore migration is orders of magnitude smaller than that observed in irradiated pins. (NL)

8305 Ultrasonic trepanning technique for radial sampling of ceramic fuel pellets. Yaggee, F.L.; Dragel, G.M. (Argonne National Lab., IL). *Nucl. Technol.*; 27: No. 2, 292-300(Oct 1975).

An ultrasonic trepanning technique for use in the radial sampling of small-diameter ceramic fuel pellets takes an initial sample in the form of a small-diameter solid cylinder from the center of the pellet. Subsequent samples are thin-wall concentric hollow cylinders. Radial samples 1.56 to 6.80 mm in diameter and 5.35 to 6.80 mm long have been obtained from 93 percent dense UO_2 pellets and 91 percent dense mixed-oxide (UO_2—PuO_2) fuel pellets. Cylindrical samples with wall thicknesses of 0.25 to 0.44 mm can be obtained without difficulty. Diameters and wall thicknesses of individual samples and concentricity between samples can be held within +—0.01 mm, at a sample cutting rate of 0.02 mm/s. The technique has been adapted to existing ultrasonic grinding equipment located in a shielded glove-box facility, which had been used for less precise ultrasonic drilling operations. The technique is currently being used to obtain radial samples from fresh (unirradiated) mixed-oxide fuel pellets that have been subjected to low-burnup exposure in the transient test reactor (TREAT). The individual samples taken from each pellet undergo burnup analysis using standard gamma-counting techniques. The gamma emitters are the ^{140}Ba—^{140}La daughters formed during the radioactive decay of the activated fuel pellets. The analytical results, expressed as fiss/(g s), obtained for discrete radial locations provide the necessary information on the radial power distribution within the individual pellet. (auth)

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 8603, 9236

8306 (CONF-750515—, pp 93-103) **Regulatory perspective of selecting, training, and licensing of personnel for fuel cycle facilities.** Clark, A.T. (U.S. Nuclear Regulatory Commission, Washington, DC). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

A guide is presented which provides general qualification requirements for the plant manager, operations manager, maintenance manager, technical managers, quality assurance manager, supervisors, professional technical staff, and technical support personnel, operators, technicians, repairmen, and temporary personnel. Subject areas for training both licensed and unlicensed personnel are given. (auth)

8307 (CONF-750515—, pp 105-116) **Atlantic Richfield Hanford Company, chemical operator training program.** Zumhoff, R.G. (Atlantic Richfield Hanford Co., Richland, WA). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

Formal training and testing of Chemical Operators at Hanford were initiated as part of a negotiated union settlement in 1966. The training and testing program was developed in two parts. The first covered subjects of a general nature and was applicable to an operator's duties no matter what the assignment. Part II was more specifically oriented to the presently assigned work area. Renewed interest in retraining and requalification of all chemical operators was taken in 1971. This evolved from a Company concern that a program be developed to assure the fact that operators were qualified to do their assigned jobs, and an Atomic Energy Commission request for an outline of a retraining and requalification program for chemical operators. Building upon the experience gained in the LNCO (Lead Nuclear Chemical Operator) program, the two-part format is retained. The use of video tapes is used to complement the manuals. A small studio for in-house production of the video tapes is available to the training Specialists. A script is developed from a training manual by condensing the information into 20-minute presentations. A prime objective of each tape is to highlight the safety and control aspects that accompany operator responsibilities in each of these areas. Testing is also handled on a two-part basis; one test covers the fundamentals and a separate test is designed for each of the plant subjects. A walk-through examination is also performed for the plant portion. Operators are required to be requalified on emergency procedures on an annual basis and at two-year intervals in the other areas. (auth)

8308 (CONF-750515—, pp 117-132) **Operator training at the Idaho Chemical Processing Plant.** Pearson, L.G. (Allied Chemical Corp., Idaho Falls). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

Classroom and on-the-job training has been conducted for the operating crews at ICPP since the beginning of plant operation in 1952. In the ensuing years, further emphasis was placed on developing a high-quality operating staff to meet the increasingly stringent operating requirements. Early in 1970, it became evident that a formal training program was essential to meet and document all the training requirements then in effect. A description is given of the program developed and implemented to meet these needs. (auth)

8309 (CONF-750515—, pp 141-151) **Review of training methods employed in nuclear fuel fabrication plants.** Box, W.D.; Browder, F.N. (Oak Ridge National Lab., TN). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

A search of the literature through the Nuclear Safety Information Center revealed that 86 percent of the incidents that have occurred in fuel fabrication plants can be traced directly or indirectly to insufficient operator training. In view of these findings, a review was made of the training programs now employed by the nuclear fuel fabrication industry. Most companies give the new employee approximately 20 hours of orientation courses, followed by 60 to 80 hours of on-the-job training. It was concluded that these training programs should be expanded in both scope and depth. A proposed program is outlined to offer guidance in improving the basic methods currently in use. (auth)

8310 (CONF-750515—, pp 153-160) **Allied-General operator training program.** Ayers, A.L.; Ebel, P.E. (Allied-General Nuclear Services, Barnwell, SC). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

All operators at Allied-General Nuclear Services are initially trained in the basic concepts of radiation and radiation protection, they are drilled in the basic technical tools needed for further training, they are instructed in the design and operation of the Barnwell Nuclear Fuel Plant, and they are introduced to the actual operations via operating procedures. This all occurs during the Before-the-Baseline training phase and then the operators move on Beyond-the-Baseline. There they physically learn how to do their job at their own pace using checklists as a guide. All operators are then internally certified. Progression is based on demonstrated ability and those that qualify go on to jobs requiring NRC licenses. Upon internal certification, retraining commences immediately and will continue in its four month, one year, and two year cycles. Current feedback from the various classes that have completed the courses and are now in the retraining program indicates that this combination of initial technical training, on-the-job training, and retraining will produce and maintain effective, safe, and efficient operators. (auth)

8311 (CONF-750515—, pp 161-170) **Chemical plant personnel training, Rocky Flats Division, Dow Chemical U.S.A.** Haugum, S.E. (Dow Chemical U.S.A., Golden, CO). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

Described are training techniques used to prepare personnel for handling radioactive materials and specialized equipment. A plutonium recovery plant utilizes procedures, equipment, and facilities not normally found in other types of processing. New Chemical Process Operators require a high school degree or equivalent with no training or testing requirements, so training provides a basis for operators to work with various kinds of equipment. A Safety and Work Indoctrination Check Sheet is completed, and 12 major job assignments are studied in depth before new personnel are assigned to production shifts. The training

techniques used are audio-visual intermixed with equipment displays, lectures, tours, and on-the-job training. The final goal is to advance operators in a three-year program, to prepare them for job assignments in a new plutonium recovery plant under construction, and for future environmental and energy programs which are being established. (auth)

8312 (CONF-751101—26) **Resin-based preparation of HTGR fuels: uranium loading development studies.** Haas, P.A. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Uranium leading flowsheet conditions for recycle ^{233}U were investigated and demonstrated in engineering equipment. Calculations made to estimate the capacities of equipment which is geometrically safe with respect to control of nuclear criticality indicate 100 kg/day or more of uranium for a single nitrate extraction line with four batch loading contactors. The four batch contactors might be replaced by a single continuous resin loading contactor of a modified Higgins contactor design. The resin loading process using solvent extraction of nitrate appears practical for use in a commercial-scale HTGR fuel recycle plant. (auth)

8313 (DOCKET-50201—171) **West Valley Reprocessing Plant. Safety analysis report, supplement 17.** (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 31 Oct 1975. 129p.

Responses to U. S. Nuclear Regulatory Commission questions on seismology and geology, meteorology, and hydrologic engineering and revised pages and replacement drawings are contained in this supplement. (LK)

8314 (DOCKET-50201—172) **West Valley Reprocessing Plant. Environmental report No. 18, January—June 1975.** (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 25 Aug 1975. 30p. Dep. NTIS $5.00.

Environmental conditions and discharge data from the West Valley Processing Plant during the first half of 1975 are reported. (LK)

8315 (DOCKET-50201—173) **West Valley Reprocessing Plant. IE inspection report No. 75-8.** (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 1 Dec 1975. 14p. Dep. NTIS $3.50.

Results of an inspection of the West Valley Processing Plant on October 20-23, 1975 are reported. The inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspector. No items of noncompliance were observed. (LK)

8316 (DOCKET-50332—55) **Barnwell Nuclear Fuel Plant. Environmental report, October 1975 update.** (Allied-Gulf Nuclear Services, Barnwell, S.C. (USA)). Oct 1975. 38p. Dep. NTIS $5.00.

Allied-General's plans for solid waste storage and on ground water at the Barnwell site are discussed. (LK)

8317 (DOCKET-701308—4) **Midwest Fuel Recovery Plant. Safety evaluation report related to license amendment.** (General Electric Co., San Jose, Calif. (USA). Nuclear Fuels Dept.). Dec 1975. 34p. Dep. NTIS $5.00.

Results of the safety evaluation relevant to the application by General Electric to amend its materials license to receive and store irradiated fuel in the Morris operation are reported. (LK)

8318 (DOCKET-701308—5) **Midwest Fuel Recovery Plant. Environmental impact appraisal related to license amendment.** (General Electric Co., San Jose, Calif. (USA). Nuclear Fuels Dept.). 3 Dec 1975. 52p. Dep. NTIS $5.50.

The environmental aspects of the proposed amendment to increase the spent fuel receipt and storage capacity at the Morris Operation facility from 100 metric tons of uranium to 750 metric tons of uranium by redesigning storage baskets and racks are discussed. (LK)

8319 (GA-A—13546) **Interim development report for primary burning.** Stula, R.T.; Young, D.T.; Yip, H.H. (General Atomic Co., San Diego, Calif. (USA)). 5 Jan 1976. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

High-Temperature Gas-Cooled Reactors (HTGRs) utilize graphite-base fuels. Fluidized-bed burners are being employed successfully in the experimental reprocessing of these fuels. The primary fluidized-bed burner is a unit operation in the reprocessing flowsheet in which the graphite moderator is removed. A detailed description of the development status of the primary fluidized-bed burner as of July 1, 1975 is presented. Experimental work to date performed in 4- and 8-in.-diam primary burners has demonstrated the feasibility of the primary burning process and at the same time has defined more clearly the areas in which additional experimental work is required. The design of a 16-in.-diam primary burner is discussed with emphasis placed upon individual components and detailed discussions of the evolution of the current design and operating philosophy. (auth)

8320 (HEDL-TME—75-136) **Hydrogen reduction of mixed-oxide fuel: reaction kinetics and their application to fuel processing.** Woodley, R.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1976. Contract E(45-1)-2170. vp. Dep. NTIS $5.50.

The hydrogen reduction kinetics of $U_{0.75}Pu_{0.25}O_2$ have been investigated over the temperature interval 1000 to 1400°C and at hydrogen flow rates not limiting to the reduction rate. Under these conditions, reduction is controlled by the rate of reaction of hydrogen with the oxygen ions of the fuel surface. The decrease in fuel oxygen with time follows a rate expression analogous to the Zeldovitch equation, indicating a linear increase in the activation energy with increasing Pu^{+3} concentration. No effect on the reduction rate of a fourfold variation in the fuel surface area was noted. (auth)

8321 (ICP—1081) **Remote maintenance development, June 1974—July 1975.** Jacobs, R.T. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Oct 1975. Contract E(10-1)-1375. 33p. Dep. NTIS $4.00.

The results of the first year's effort to develop techniques and equipment for performing maintenance on the New Waste Calcining Facility (NWCF) are presented in this report. Modifications made to commercially available connectors are described, and test data from mockups using both the Bridge Crane and the PAR Manipulator systems of remote handling are discussed. The preliminary use of three-dimensional television as a remote maintenance concept is also discussed. (auth)

8322 (GERHTR—139) **Tritium in reprocessing plants: a study of the inventory, behavior, and the possibilities of separation of the tritium isotope.** Schnez, H.; Laser, M.; Merz, E. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Chemische Technologie). Aug 1974. Translation of JUL—1099-CT. 85p. Dep. NTIS $6.00.

Work performed under United States—German High Temperature Reactor Research Exchange Program.

The path followed by tritium in reprocessing plants is described in quantitative terms based on the Purex and Thorex processes. Flowsheets are given for the Purex process which are on the one hand based on the present state of technology, but make provision at the same time for a recycling of the aqueous phase and a tritium separation. As an alternative approach the technical and economic aspects have been examined of a prior separation of the tritium after reduction of the fuel elements, followed by separation from the aqueous phase. The ultimate storage and transport of the separated tritium were included in the cost determination. The conclusion is reached as a result of the study that tritium separation is possible on scientific and technical grounds. The estimates made show the financial outlay to be less than 10 DM/GWh, but may on occasion be substantially higher, since no practical or industrial experience of the process is yet available. (auth)

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 8335, 9237, 9393

8323 (ANL-Trans—1025) **Packaging for the transport of irradiated fuel from fast neutron reactors.** Labrousse, P.M.; Lucas, H. Translated from *Bull. Inf. Sci. Tech. (Paris)*; No. 190, 47-54(Mar 1974). 20p. Dep. NTIS $3.50.

Because of the treatment of Rapsodie and Fortissimo fuel pins, irradiated in Cadarache, in La Hague, the CEA has some experience in the transport of irradiated fuel from fast breeder reactors. After a brief description of IU07 packaging designs used for this purpose, the article discusses the problems raised by the transport of Phenix reactor fuel pins and the options selected for the construction of IU11 packaging. The progress of the first studies carried out for the transport of Super Phenix assemblies is indicated in detail. (auth)

8324 **Spent fuel transportation on highways: the radioactive dose to the traffic.** Yadigaroglu, G. (Univ. of California, Berkeley). *Nucl. Technol.*; **27**: No. 2, 258-266(Oct 1975).

The radioactive exposure of the traffic moving on the same highway as spent fuel shipments has been neglected in the past. Methods developed for calculating peak exposures, the number of individuals receiving a dose in excess of a certain limiting value,

and the cumulative population doses for the occupants of the vehicles under a variety of highway and accident conditions allow comparisons to the corresponding stationary-population doses. Consideration of both routine direct-radiation exposures and accidental releases indicates that the traffic doses can be of equal or greater importance than the stationary-population doses. (auth)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 8837

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 9183

8325 (ERDA—1538(Vol.1)) **Final environmental statement, Waste Management Operations, Hanford Reservation, Richland, Washington. Volume 1.** (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1975. 593p. Dep. NTIS $13.60 (Vols. 1 and 2).

The impacts and alternatives available to the ongoing Hanford Waste Management Operations Program are presented. Environmental effects of routine operation of plant facilities are considered. Reasonable alternatives to the current program for treatment of high-level liquid radioactive waste, other radioactive liquid waste, radioactive gaseous wastes, radioactive solid waste, nonradioactive waste, and other potential environmental pollutants are given. (LK)

8326 (ERDA—1538(Vol.2)) **Final environmental statement, Waste Management Operations, Hanford Reservation, Richland, Washington. Volume 2.** (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1975. 428p. Dep. NTIS $13.60 (Vols. 1 and 2).

Volume 2 contains appendices, including maps and tabulations of inventories; demographic and archaeological data; and models and computer codes for evaluating environmental radiation doses. (LK)

WASTE PROCESSING

REFER ALSO TO CITATION(S) 8321

8327 (ANL—75-63) **Chemical Engineering Division waste management programs. Quarterly report, April—June 1975.** Steindler, M.J.; Levitz, N.M.; Mecham, W.J. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 32p. Dep. NTIS $5.00.

Consolidation techniques for Zircaloy fuel-cladding hulls were studied. They included (1) further work on a pyrochemical-volatility scheme for separating the zirconium as the volatile tetrachloride and (2) ignition tests and shock-ignition tests on several Zircaloy materials to further characterize the pyrophoric behavior of Zircaloy and the impact on hulls management. Quantitative results on the reaction with molten zinc chloride are presented. A series of steel-melting experiments examined the compatibility of various crucible materials with the molten steel and provided information on the behavior (distribution) of CeO_2 and UO_2 (used as stand-ins for PuO_2). Examination of existing information on deep-well injection of industrial wastes and on low-level aqueous wastes from fuel reprocessing led to the conclusions that the technology is generally available from industrial practice, that costs are of the order of 10^{-4} mill/kWh, that environmental effects could be insignificant in normal operation (but could include contamination of groundwater and resources and also stimulation of minor earthquakes in maloperation), that legal constraints may be the most significant barrier to adopting the practice, and that the site of such an operation would best be at a fuel reprocessing plant located at one of the U. S. sedimentary basins. The conclusions and recommendations from a study of the reliability of high-level-waste canisters are presented. (auth)

8328 (MLM—2262) **Monsanto/Mound Laboratory tritium waste control technology development program.** Bixel, J.C.; Kershner, C.J.; Rhinehammer, T.B. (Mound Lab., Miamisburg, Ohio (USA)). 30 Dec 1975. 14p. (CONF-750967—21). Dep. NTIS $4.00.

From 3. ERDA environmental protection conference; Chicago, Illinois, USA (23 Sep 1975).

Over the past four years, implementation of tritium waste control programs has resulted in a 30-fold reduction in the gaseous tritium effluents from Mound Laboratory. However, to reduce tritium waste levels to the "as low as practicable" guideline poses problems that are beyond ready solution with state-of-the-art tritium control technology. To meet this advanced technology need, a tritium waste control technology program was initiated. Although the initial thrust of the work under this program was oriented toward development of gaseous effluent treatment systems, its natural evolution has been toward the liquid waste problem. We contend that, of all the possible approaches to disposal of tritiated liquid wastes, recovery offers the greatest advantages. End products of the recovery processes would be: (1) water detritiated to a level below the Radioactivity Concentration Guide or detritiated to a level that would permit safe recycle in a closed loop operation and, (2) enriched tritium. The detritiated water effluent could be either recycled in a closed loop operation such as in a fuel reprocessing plant or safely released to the biosphere, and the recovered tritium could be recycled for use in fusion reactor studies or other applications. (auth)

8329 **Management of commercial radioactive waste in the United States.** Pittman, F.K. (Energy Research and Development Administration, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **21**: No. 2, Suppl., 33(1975).

From Nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975).

See CONF-750928—.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 8327, 8329, 8335, 9393

8330 (ANL—75-64) **Annual report on DWMT project AN0115A, FY 1975.** Fried, S.M.; Friedman, A.M.; Hines, J.J.; Quarterman, L.A. (Argonne National Lab., Ill. (USA)). Sep 1975. Contract W-31-109-Eng-38. 14p. Dep. NTIS $4.50.

Migration of Pu and Am in rocks and soils were studied using computer and laboratory-scale models. Surface absorption coefficients of Am were measured on tuff. (DLC)

8331 (BNL—20779) **Tritium storage development. Progress report No. 5, July—September 1975.** Colombo, P.; Steinberg, M.; Manowitz, B. (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1975. 37p. Dep. NTIS $4.00.

Various prospective cement concrete formulations for tritium immobilization were analyzed thermogravimetrically (TGA) to allow their behavior in a thermal environment relative to tritium release to be ascertained. Curing exotherms of large neat cement castings were found to be appreciable. Methods are discussed to decrease these exotherms. Process development for large-scale cement castings has continued. Equipment was received to allow the development of a drum tumbler mixing technique to be initiated. (auth)

8332 (BNWL—1940) **Program plan for comprehensive characterization of solidified high-level wastes.** Mendel, J.E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-1830. vp. Dep. NTIS $5.45.

An experimental plan is described for in-depth characterization of canistered solidified waste forms for the storage and disposal of high-level radioactive wastes. The plan is being considered for silicate glass forms at PNL. The basic aspects of the plan have general application and can be applied to other candidate waste forms as well. The plan is designed to define the behavior of waste canisters and their contents during anticipated handling, storage, and disposal regimes. Particular emphasis is placed on long-term thermal and radiation effects. A 10-year period is projected for complete characterization of any one basic type of waste form, e.g., silicate glass cast in metal canisters. A preponderance of the laboratory effort occurs in the first 5 years. It is assumed that shortly thereafter an operating solidification plant will be available, so that much of the second 5 years can be devoted to corroborative tests made on representative canisters of actual high-level waste. Manpower requirements are estimated at 65 scientist man-years during the first 5 years and 30 scientist man-years during the second 5 years. (auth)

8333 (DPST—75-218) **Soil moisture flow as related to the burial of solid radioactive waste.** Horton, J.H. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jan 1976. Contract AT(07-2)-1. 19p. Dep. NTIS $3.50.

By understanding water flow through the normally water-unsaturated soil above the groundwater table and applying this knowledge to the design of a radioactive solid waste burial procedure it is possible to minimize leaching of radionuclides from the waste. This is accomplished by minimizing water saturated soil which is in contact with the waste. (auth)

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 8301, 9095

8334 (SAND—75-6068) **Protecting plutonium: physical safeguards.** Ney, J.F. (Sandia Labs., Albuquerque, N.Mex. (USA)). Oct 1975. 24p. (CONF-751055—1). Dep. NTIS $4.50.

From AIF workshop on the nuclear debate) basic issues for 1976; Boston, Massachusetts, USA (29 Oct 1975).

In the development of physical protection systems, objectives for improving overall performance include the following: (1) Increase the time required for the malefactor to achieve his goal; (2) decrease the time required for detection of malevolent activities; (3) reduce the time for adequate response force arrival; (4) increase the capability to neutralize the malefactor; (5) reduce the total protection system costs, while increasing the level of protection; (6) improve acceptance levels (social, environmental, legal, and institutional); and (7) increase nuclear fuel cycle safety. Fortunately, there is sufficient lead time and technical base to explore and develop new protection system concepts so that a completely integrated and tested protection system capable of providing unprecedented levels of security can be available when needed. Although it will be impossible to completely eliminate all risks, it should be both possible and economically feasible to install protection systems which will deter or prevent a malefactor from using the nuclear fuel cycle to disrupt society. (auth)

8335 **In-line station for volume calibration of Raschig-ring-filled storage tanks for fissile solution.** Rothe, R.E.; Doher, L.W.; Johnston, A.L. (Rockwell International, Golden, CO). *Nucl. Technol.;* **28**: No. 1, 165-171(Jan 1976).

A station was installed at the Rocky Flats Nuclear Safety Laboratory to volume-calibrate their storage tank farm housing 560 kg of enriched (93.2 percent ^{235}U) uranium solution. The calibration (relating contained solution volume to height) of tanks used to store or process fissile materials is often complicated by the large surface area presented by thousands of borosilicate glass rings used for criticality prevention. Yet, an accurate and reliable measurement of this relation is important to good material accountability and possibly to nuclear safety. The latter purpose can be served by detecting accumulations of insoluble precipitates or the formation of critically unsafe voids in the bed of rings. With this station, calibrations are easily accomplished with an accuracy better than 1 liter at any point within a 500-liter tank. Additional benefits include increased safety through reduced potential for contamination release, improved efficiency since one operator replaces the previously required two, and the complete elimination of both solid and liquid contaminated waste generation. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

8336 (COO—2569—1) **Luminescence process, refractory stabilities, and new and novel electronic states: scanning chemical reactions and novel products for laser induced isotope separation. Progress report, March 1, 1975—November 20, 1975.** Gole, J.L. (Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1975. Contract E(11-1)-2569. 27p. Dep. NTIS $4.00.

The formulation and development of versatile oven systems for high temperature metal vaporation at temperatures greater than 2000°C are discussed. The construction of an apparatus appropriate to the production and study of small metal aggregates M/sub n/ (2 less than or equal to n less than or equal to 6) is discussed at length. This includes a consideration of the construction and operation of an argon ion pumped dye laser system. The dye laser system will be used to induce fluorescence from the small metal aggregates, and thereby will lead to the study of their molecular electronic structure. The production of carbon vapor and the reaction of this vapor with metal atoms and metal dimers to form metal carbides is outlined. A thorough study of the luminescence process leading to a new understanding of those chemiluminescent phenomena occurring as a result of the "single collision" bimolecular reaction of metal atoms and metal dimers with select oxidants is outlined. Methods for the determination of upper bounds to the heats of sublimation and vaporization of those metals which can be strongly oxidized in a "single collision" bimolecular reaction are presented. Extremely simple methods by which one can infer the radiative lifetimes of metastable product chemiluminescing molecules are also discussed. Beginning efforts toward the formulation of new and novel catalytic surfaces via aggregate deposition are outlined. Current studies of the titanium oxide system are presented. These chemiluminescence studies allow the determination of a lower bound to the TiO dissociation energy and a determination of the heat of vaporization of titanium metal. (auth)

8337 **TRISTAN on-line isotope separator facility.** McConnell, J.R.; Talbert, W.L. Jr. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). *Nucl. Instrum. Methods;* **128**: No. 2, 227-243(1 Oct 1975).

The TRISTAN facility consists of an isotope separator and associated nuclear spectroscopy equipment located at the Ames Laboratory Research Reactor. It is used for on-line studies of short-lived neutron-rich nuclides produced by fission of enriched ^{235}U. The facility is first described in terms of the target and neutron irradiation system along with the associated transport line. Next, the isotope separator is described with emphasis placed on developments of components for on-line operation, and results obtained from tests for mass purity. Ion beam handling to several detector stations through the use of a switching magnet is discussed along with a description of the stations. Also included are the design considerations of a moving tape collector and its drive electronics; retention measurements on tape material; control unit for time sequencing of beam, data accumulation, and tape transport; detector station for study of delayed neutrons; and a high-resolution $\pi\sqrt{2}\beta$-ray spectrometer. Some of the operational experiences over an eight-year period are discussed. (NL)

RADIATION SOURCES

REFER ALSO TO CITATION(S) 9186

8338 **Portable flash x-ray systems: applications and techniques.** Bryant, L.E. Jr. (Los Alamos Scientific Lab., NM). *Mater. Eval.;* **33**: No. 12, 273-278(Dec 1975).

Advantages, limitations, applications and techniques are given for 180 kV, 600 kV and 2.0 MeV portable flash x-ray systems. Suggestions are made for protection of equipment and film, for accurate pulse-triggering, and for obtaining high-quality images under the constraints of blast and shrapnel from explosions. There are flash radiographs illustrating bullet impacts, jet phenomena, demolition device and fragmentation device studies. (auth)

8339 (UCRL—51860) **Pinhole for producing a close-in image of an extended 14-MeV neutron source.** Matthews, S.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1975. Contract W-7405-Eng-48. 50p. Dep. NTIS $4.00.

In pulsed-neutron pinhole imaging experiments, it is desirable to produce images of extended 14-MeV neutron sources close to the source itself to minimize time-of-flight distortions. "Close" means that the thickness of the pinhole barrier is not negligible in comparison with the distance from the source to the image plane. A pinhole assembly capable of producing close-in images extended 14-MeV neutron sources was designed and used in a number of experiments. A computer program was devised to predict the performance of the pinhole by calculating the distribution of neutrons incident on the image plane from a neutron point source in the source plane. The calculation of the image-plane neutron distribution takes into account edge penetration through the barrier and is a function both of the neutron mean free path in the barrier material and of the system geometry. (auth)

8340 (AEC-tr—7315, pp 22-27) **Calculation of the temperature fields of extended irradiators.** Stepanov, G.D.; Osipov, V.B. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The production of powerful radiation equipment is related to the forming of extended irradiators of different geometry with considerable total and specific activities. This leads to the release of a higher amount of heat in the irradiator's zone. This is due to the absorption of radiation by the sources and constructional materials, which may cause unacceptable heading up of the standard radiation sources and undesirable thermal deformation of the irradiator. Thus, it is necessary to determine the temperature fields of the irradiators, and to provide the necessary conditions for their normal functioning. (auth)

8341 (AEC-tr—7315, pp 28-34) **Forming of the dose field of a spiral type irradiator.** Terent'ev, B.M.; Dubnova, S.K.;

Kupriyanova, I.A. 1971. Translated from Radiats. Tekh.; No. 6, (1971).
In Radiation Technology, Issue 6.

An irradiator of the linear type was used in the earlier equipment for radiation for the realization of low-energy radiation-chemical processes in the aqueous phase. However, this irradiator cannot always provide the necessary medium dose rate in the given volume, e.g., in equipment of high capacity, i.e., with a high reaction volume. In this case it is suitable to use, instead of the linear irradiator, an irradiator in which the radioactivity is distributed along a spiral. A method for calculating the dose field for such an irradiator is presented. (auth)

8342 (AEC-tr—7315, pp 37-40) **Calculation of systems with a plane irradiator and block objects of a small density.** Vikulin, A.A.; Terent'ev, B.M.; Sivitsku, V.S. 1971. Translated from Radiats. Tekh.; No. 6, (1971).
In Radiation Technology, Issue 6.

Irradiation of block objects characterized by small density values, is frequently encountered in some radiation processes (radiation for sterilization, e.g., irradiation of diverse medical articles whose density rho less than or equal to 0.3 gm/cm^3. It is important to clarify, whether it is necessary to consider multiple scattering in the calculation of the dose rate field in the irradiated object with the indicated density values. This problem was decided for several values of 'rho' for a tissue-equivalent block, and for air where multiple scattering is practically absent, i.e. the accumulation factor is equal to 1. (auth)

8343 (AEC-tr—7315, pp 40-48) **Choice of a radiation source activity and calculation of dose fields for in-cavity irradiation on a hose apparatus.** Episyutin, G.P.; Rimman, A.F.; Zhokovsku, E.A.; Kheteev, M.V.; Sul'kin, A.G.; Komar, V.Ya. 1971. Translated from Radiats. Tekh.; No. 6, (1971).
In Radiation Technology, Issue 6.

The main problem in the working out of a hose γ-therapeutic apparatus for in-cavity irradiation, is the creation of a dose field promoting maximum destruction of the carcinogenic cells and minimum radiation load on the healthy tissues. Since the possibility of placing radiation sources and production of complex three-dimensional irradiators is determined by the dimensions and form of the cavities, certain limits are put on the geometrical parameters of the irradiators. The irradiator, having the most frequently used form in radiogynaecology, is formed from a combination of a linear source for the uterine canal (tube) and two linear or point sources placed in the canopies of the vagina. Such a system for placing the sources in in-cavity irradiation together with remote irradiation is sufficiently effective for the majority of the gynaecological localizations. Therefore, it is necessary in the first place to have the possibility of evaluating dose fields created by different combinations of sources of radiation positioned according to this system. It is also necessary to substantiate the choice of the radioactive isotope, and the activity of the diverse sources included in the irradiator (combination). A scheme for accomplishing these objectives is presented. (auth)

DESIGN AND FABRICATION

8344 (AEC-tr—7315, pp 108-115) **Some features of a pulse proton generator.** Kir'yanov, G.I.; Dadonov, A.M.; Dereza, K.K. 1971. Translated from Radiats. Tekh.; No. 6, (1971).
In Radiation Technology, Issue 6.

A proton source for use in activation analysis is described. A beam of deuterium ions, generated in an ion source and accelerated by an acceleration tube, bombard a target saturated with ^{3}He. Protons are formed through the reaction ^{3}He(d,p)^{4}He and their energy is 15 MeV. (TFD)

8345 (AEC-tr—7315, pp 148-154) **Experimental hose γ-therapeutic apparatus for in-cavity irradiation.** Rimman, A.F.; Sul'kin, A.G.; Komar, V.Ya.; Zhukovsku, E.A. 1971. Translated from Radiats. Tekh.; No. 6, (1971).
In Radiation Technology, Issue 6.

The use of high dose rates of γ-radiation, in the in-cavity radiation therapy, offer a number of advantages over the methods applied at present for irradiation with the use of sources of relatively low activity. However, the wide introduction of this method is hindered by the uncertainty of some factors of biological and clinical character, by the absence of exact data about the dose distribution in the direct vicinity of radiation sources and the respective equipment. The experimental model of the dose γ-therapeutic apparatus for in-cavity irradiation, worked out by VNIIRT is described. (TFD)

8346 (AEC-tr—7315, pp 154-162) **Theoretical basis of the design of single-spiral spring counterbalances of radiation equipment.** Sul'kin, A.G. 1971. Translated from Radiats. Tekh.; No. 6, (1971).
In Radiation Technology, Issue 6.

The spring counterbalances with a single-spiral compensator, applied in radiation equipment, are subdivided into two modifications [1]. The first modification has the spiral part connected by a flexible element to the balancing weight, and the cylindrical part is connected to the balancing spring (the arm of the balancing force is fixed). While for the second modification, the spiral part of the compensator is connected to the spring and the cylindrical part is connected to the load (the arm of the balanced constant force is fixed). The connection of the balancing spring with the compensator is realized either directly through the flexible element (cable, chain), or by the means of a movable block that permits to increase the hardness of the spring at the same energy capacity and consequently to decrease its overall dimensions. Equations for calculating the profile of the spiral are presented. (auth)

8347 (AEC-tr—7315, pp 186-192) **Additional hermetic sealing of the β-radiation source BIS-M.** Nikolaev, A.A.; Chubkov, V.N. 1971. Translated from Radiats. Tekh.; No. 6, (1971).
In Radiation Technology, Issue 6.

The aim of the present work is the widening of the limits of efficiency of the ampoule of the ^{90}Sr source BIS-M (MRTU-10-64-65), for its application in articles operating under the following conditions: temperature of the surrounding medium changes from −60 yields +50°C; relative humidity up to 98 percent; thermal collision at a temperature of 300°C during 2 min.; acceleration 0.1 to 10 g; vibration 1 to 25, 25 to 200, 200 to 600, and 600 to 2000 hertz with accelerations up to 1, 6, 8, and 12 g respectively; pressure of the medium 1 to 6 gauge atmosphere; corrosive medium. (auth)

USE IN MEDICAL SUPPLY STERILIZATION

8348 (AEC-tr—7315, pp 170-177) **Sterilization of medical articles from polymeric materials by a linear electron accelerator.** Vanyushkin, B.M.; Kon'kov, N.G.; Korzhenevsku, Z.S.; Krylov, S.Yu.; Povalikhin, N.S. 1971. Translated from Radiats. Tekh.; No. 6, (1971).
In Radiation Technology, Issue 6.

The design and operating parameters of the industrial assembly are described. (TFD)

OTHER INDUSTRIAL USES

REFER ALSO TO CITATION(S) 9523

8349 (SAND—75-0580) **Waste Resources Utilization Program. Progress report, period ending September 30, 1975.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 29p. Dep. NTIS $4.00.

The purpose of the Waste Resources Utilization Program is to develop a technology to constructively couple two major environmental problems, disposition of human and nuclear waste, in an attempt to provide a framework in which both will become useful resources. Sludge treated with thermoradiation offers considerable potential for use as a fertilizer in agriculture or a soil conditioner for land reclamation free of the serious potential health hazards associated with conventional methods of land disposal. In addition, the very real possibility exists that treated sludge may provide a low-cost substitute for high-nutritional components in ruminant diets. The liter size flow-through system is put into operation for the first time and provides sufficient quantities of treated sludge for good biological analysis and to start the animal feeding program at New Mexico State University. Approximately 3800 gal of sewage sludge were thermoradiation-treated with the system. The sludge was exposed to approximately 150 krads of gamma radiation at a temperature of 65°C. The treated sludge was monitored for elimination of total coliforms and fecal strep. No fecal strep bacteria were found in 400 sample plates; three contained coliform growth. An intensive study of poliovirus inactivation in sewage sludge was completed this quarter. Source efficiencies were calculated for possible modification to the WESF capsule which would consist of inserting a hollow tube in the center of the capsule. This was proposed as a simple modification to the standard WESF capsule to reduce the self-shielding characteristic of the cesium. The calculations showed little or no advantage of adding the center tube. (TFD)

ISOTOPIC POWER SUPPLIES

REFER ALSO TO CITATION(S) 9989

8350 (ORNL—5046, pp 239-246) **Nuclear-powered Cardiac pacemakers.** Shoup, R.L. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

The radiological hazards and benefit assessment of ^{238}Pu-powered cardiac pacemakers are analyzed. (TFD)

HYDROGEN

REFER ALSO TO CITATION(S) 8840, 8841, 8842

PRODUCTION

REFER ALSO TO CITATION(S) 8175

8351 Method of manufacturing high quality reducing gas by two stage reforming processes. Miyashita, I.; Ozeki, S.; Nishio, H.; Nayuki, T.; Kobayashi, T.; Suzuki, G.; Murakami, T. (to Nippon Kokan Kabushiki Kaisha). US Patent 3,909,446. 30 Sep 1975. Priority date 31 Mar 1972, Japan. 14p.

Liquid hydrocarbon containing substances such as crude oil, fuel oils, and heavy oils or solid hydrocarbon containing substances such as coal and plastic scraps or discards are used as the source of hydrocarbon. Gas containing hydrocarbons produced by the heat decomposition of the source of hydrocarbon, or a gas mixture produced by admixing a gas produced by gasifying, atomizing or pulverizing the source of hydrocarbon with coke oven gas or a gas produced by heat decomposing the source of hydrocarbon by the action of steam containing oxygen, or by the action hydrogen, is admixed with furnace top gas discharged from the top of a reducing furnace and containing CO_2 and H_2O, and resulting gas mixture is converted into the reducing gas consisting essentially of CO and H_2 while the gas mixture is maintained at a predetermined high temperature. (Official Gazette)

THERMOCHEMICAL PROCESSES

8352 (LA-UR—75-2375) **Reduction of hydrogen bromide using transition metal compounds.** Mason, C.F.V. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 14p. (CONF-760304—1). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America "USA" (1 Mar 1976).

Ways of accelerating the redox reaction between chromous bromide and hydrogen bromide to form chromic bromide and hydrogen are examined at room temperature. The process, although thermodynamically favorable, is extremely slow kinetically. Marked increases in rates have been obtained by using the hydrate, pyridine and dipyridyl complexes of chromium. In conjunction with catalysts, hydrogen yields of up to 71 percent in 10 minutes have been obtained. The significance of these results is discussed in the framework of closed thermochemical cycles for preparing hydrogen. (auth)

8353 (LA-UR—76-72) **Progress in the Los Alamos Scientific Laboratory program to develop thermochemical processes for hydrogen production.** Bowman, M.G. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 13p. (CONF-760304—4). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America "USA" (1 Mar 1976).

The Los Alamos Scientific Laboratory Program to develop thermochemical processes for hydrogen production is based on attempts to develop criteria required of an ideal process and to search for types of thermochemical cycles that approximate these criteria. The advantages of reactions with large entropy changes have been demonstrated. The necessity for experimental verification of conceptual cycles has become apparent from the program. This necessity has been stressed in the paper. It should be emphasized that any comparison of conceptual cycles or of engineering or cost analyses must eventually be based on real, rather than assumed, data. (auth)

STEAM REFORMER PROCESSES

8354 Hydrogen-rich gas generator. Houseman, J. (to California Inst. of Tech.). US Patent 3,920,416. 18 Nov 1975. Filed date 26 Dec 1973. 10p.

A process and apparatus for producing a hydrogen rich gas from liquid hydrocarbon and water using the partial oxidation steam reforming process is described. (auth)

8355 Hydrogen process. Seitzer, W.H. (to Sun Ventures, Inc.). US Patent 3,920,804. 18 Nov 1975. Filed date 16 Sep 1974. 2p.

In the process of making hydrogen by reforming hydrocarbons with steam, the improvement which comprises preheating the steam to a temperature of at least 3,600°F before its introduction to the reforming reactor is described. (auth)

COAL GASIFICATION

REFER ALSO TO CITATION(S) 8203

STEAM-IRON PROCESS

REFER ALSO TO CITATION(S) 8166

PARTIAL OXIDATION PROCESSES

REFER ALSO TO CITATION(S) 8354

8356 Synthesis gas production by partial oxidation. Slater, W.L. (to Texaco Inc.). US Patent 3,920,579. 18 Nov 1975. Filed date 24 Apr 1974. 8p.

Compounds of Group I alkali metals (i.e., Na, K, Li, or mixtures thereof) are added to the feed to the reaction zone of a partial oxidation synthesis gas generator in order to raise the level of said alkali metals to a value in the range of about 350 to 13,000 parts per million (basis weight of hydrocarbonaceous fuel feed), or more. By this means, the partial oxidation reaction may be improved. Soot formation is reduced or oxygen consumption is decreased, or both. Further, the subject process may be useful for the recovery of naturally occurring metal values that may be present in the hydrocarbonaceous fuel feed. Thus heavy metal compounds of Ni, V, and Fe in the hydrocarbonaceous fuel may be fluxed with said alkali metals in the reaction zone of the gas generator to facilitate their separation from the process gas stream, and to extend the life of the refractory lining of the reaction zone. (auth)

STORAGE

CHEMISORPTION

REFER ALSO TO CITATION(S) 8360

8357 (BNL—20791) **Titanium alloy hydrides; their properties and applications.** Reilly, J.J.; Johnson, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 24p. (CONF-760304—6). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America "USA" (1 Mar 1976).

Certain reversible metal hydrides have been proposed as energy storage media. One of these, titanium iron hydride, has already been used in a pilot scale demonstration for this purpose. The formation and properties of other titanium alloy hydrides which are also of interest in this connection are discussed. Particular emphasis will be given to a class of ternary alloys having composition corresponding to TiFe/sub x/M/sub y/, where M is a transition metal. It has been determined that many alloys of this type will react directly and reversibly with hydrogen to form hydrides. The properties of these hydrides vary and are dependent on the particular transition metal substitute and its quantity. The integration of such materials with energy storage systems and their relative advantages are also discussed.14 figures (auth)

8358 (BNL—20876) **Behavior of iron titanium hydride test beds: long-term effects, heat transfer and modeling.** Strickland, G.; Milau, J.; Yu, W.S. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 31p. (CONF-760304—8). Dep. NTIS $4.00.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America "USA" (1 Mar 1976).

Several types of studies were made with test beds of iron titanium hydride (FeTiH/sub x/) in order to determine their long-term and thermal behavior. This material provides a way of storing hydrogen in relatively dense form at ordinary temperatures and moderate pressures. Its use offers electrical utilities a way of storing low-cost off-peak power, to meet costly peak-shaving needs, in combination with an electrolyzer and a fuel cell stack. The data obtained are part of that needed for the design of plant-scale hydride reservoirs. Accelerated cyclic tests were made with 1-in.-diam test beds to determine changes in their long-term behavior,

the main result being extensive particle attrition. The thermal behavior of a 6-in.-diam test bed was determined along with the times that various hydrogen flow rates could be sustained during hydriding and dehydriding. Modeling studies were made for the purpose of understanding and characterizing the behavior of this test bed, and for scaling up the design. A description of each test bed accompanies the data and information obtained from its operation. 16 fig, 7 tables (auth)

8359 (BNL—20902) **Hydrogen storage via iron—titanium for a 26MW(e) peaking electric plant.** Beaufrere, A.H.; Salzano, F.J.; Isler, R.J.; Yu, W.S. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 21p. (CONF-760304—5). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America *USA* (1 Mar 1976).

Work is in progress at the Brookhaven National Laboratory for the development of bulk storage techniques for hydrogen using iron-titanium. The program consists of a variety of activities which include engineering analysis and design of a large bulk hydrogen storage facility, engineering-scale tests, work on the selection and development of suitable iron-titanium alloys, and the construction of a large prototype energy storage system. Based on these engineering studies, a preliminary plant design and cost estimate is presented for a 26 MW(e) hydrogen storage peaking electric power plant, with hydrogen production via water electrolysis, iron-titanium metal hydride hydrogen storage beds and hydrogen-air fuel cells for reconversion to electricity. Cost estimates of a similar plant incorporating advanced technology components are made and compared with allowed costs for such systems. Description of R & D requirements to achieve these goals is discussed. (auth)

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 8911

8360 (AD/A—007353) **Complex metal hydrides. High energy fuel components for solid propellant rocket motors. Annual report, 1 January—31 December 1974.** Ashby, E.C. (Georgia Inst. of Tech., Atlanta (USA)). 31 Dec 1974. Contract N00014-67-A-0159-0005. 185p. NTIS $7.00.

See also report dated 15 Feb 1974, AD—774129.

During the contract period, work has continued on the preparation and structure elucidation of simple and complex metal hydrides of the main group elements. The new hydrides $Mg(ZnH_3)_2$ 4 are reported for the first time as well as new and simple routes for the preparation of complex metal hydrides of beryllium; e.g., Li_2BeH_4 and Li_2BeH_6. (GRA)

PROPERTIES

8361 (SAND—75-8695) **Time-averaged measurements in turbulent flames using Raman spectroscopy.** Setchell, R.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 24p. (CONF-760102—4). Dep. NTIS $3.50.

From 14. AIAA aerospace sciences meeting; Washington, District of Columbia, USA (26 Jan 1976).

Raman spectroscopy is used to obtain radial profiles of time-averaged temperature, reactant concentrations, and Raman signals from water at axial distances of 12 and 50 nozzle diameters in a turbulent hydrogen diffusion flame. Temperatures are determined from the relative intensities of both Q-branch lines of hydrogen and Q-branch bands of nitrogen. Temperatures from nitrogen spectra peak at the radial position where mean stoichiometry is observed. Temperatures from hydrogen spectra exceed the nitrogen temperatures near this position. Number densities of hydrogen, oxygen and nitrogen are determined by combining measurements of absolute intensities of Q-branch bands, temperature measurements, system calibrations using known mixtures, and calculations of the temperature dependence of spectrometer-convoluted band shapes. Fluctuations in temperature and composition within the measurement volume introduce error terms into the expressions relating time-averaged Raman signals with time-mean temperatures and concentrations. The role of spectral resolution in minimizing concentration errors is demonstrated. (auth)

OTHER SYNTHETIC AND NATURAL FUELS

HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 8183, 8202, 8822, 8910

8362 (FE—1773-11) **Development studies on conversion of methanol and related oxygenates to gasoline. Quarterly progress report No. 2, May—July 1975.** Voltz, S.E.; Wise, J.J. (Mobil Research and Development Corp., Paulsboro, N.J. (USA)). Oct 1975. Contract E(49-18)-1773. 137p. Dep. NTIS $6.00.

This reprt describes the progress in the development of the methanol-to-gasoline process in the period of May 1 through July 31, 1975. Preliminary aging runs were successfully completed in the fixed bed pilot plant. Based on the results, the catalyst and operating conditions for a long-term catalyst aging run (minimum of 3 months duration) have been selected. The results of car tests with simulated gasoline from methanol have shown that durene concentrations up to 4 wt percent have no significant effects on vehicle performance. Stability tests (i.e., existent and potential gum tests) were made on product gasolines from pilot plant runs. Gasoline products obtained from the initial and middle portions of a cycle have good stability properties. Stability is poor at the point of methanol breakthrough. Considerable progress was made in the engineering design of the 100 B/D pilot unit. (auth)

8363 (PB—240113) **Animal waste conversion systems based on thermal discharge.** Boersma, L.; Barlow, E.W.R.; Miner, J.R.; Phinney, H.K. (Oregon State Univ., Corvallis (USA)). Sep 1974. Contract DI-14-31-0001-4121. 58p. NTIS $4.25.

Also available from Oregon State Univ., Corvallis. Agricultural Experiment Station. Special rept. No. 416.

Society faces many problems related to its growth in numbers and standard of living. Of major concern is environmental degradation resulting from pollution and the consumptive use of non-renewable natural resources. An animal waste management scheme was developed on the premise that one solution to these problems is the development of integrated production systems with recycled sources. The waste product of one industry must become the raw material for another. The feasibility of using waste heat from steam electric plants to sustain a food-producing complex which recycles nutrients is analyzed. Specifically, it is proposed to use microorganisms to convert animal waste into a high protein animal feed and a methane-rich fuel gas. Waste heat from steam electric plants is used as a low cost source of energy for maintaining stable, elevated temperatures in anaerobic digestion and single cell protein production units. Benefits to society include: improved efficiency of energy use and food production, recycling of raw materials, and conservation of non-renewable resources. (GRA)

8364 **Method of reducing environmental pollution by utilizing stack gases, resulting from the burning of fossil fuels, and water, including sea water and waste water, to manufacture hydrocarbon energy fuel, potable water and other commercial products.** New, R.V. US Patent 3,820,965. 28 Jun 1974. Filed date 2 Apr 1973. 20p.

A method and apparatus is described for treating smoke stack gases diverted to minimize air pollution to recover from the stack gases the individual constituents thereof, namely, carbon dioxide (CO_2), water (H_2O) and nitrogen (N_2) freed of other products, such as oxides; and to recover from water (including nonpotable water such as sea water, waste water and even polluted water sources) the individual constituents thereof of interest here, namely, hydrogen (H_2); and delivering the recovered carbon dioxide and the recovered hydrogen into a catalytic reaction chamber under sufficiently high temperature conditions in the presence of a suitable catalyst to establish therein a reaction temperature to support a Sabatier catalytic reaction ($CO_2 + 4H_2 = CH_4 + 2H_2O$) hydrogenating the carbon dioxide to form methane for use as fuel, and potable water for commercial usage. (Official Gazette)

8365 **Energy from wastes: solid, liquid, and gaseous fuels.** Blaustein, B.D. (Energy Research and Development Administration, Washington, DC); Tosh, J.S. pp vp of In Second annual symposium on coal gasification, liquefaction, and utilization: best prospects for commercialization. Pittsburgh; Univ. of Pittsburgh (1975).

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

See CONF-750868—.

The technical feasibility of recovering energy and materials from wastes, primarily municipal solid wastes, is illustrated by a description of combustion installations for steam or power generation and pyrolysis installations for production of fuel gas or oil. The Saugus plant for steam generation and the St. Louis installation for both power generation and materials recovery are described. The Garrett flash pyrolysis process for the production of fuel oil, the Monsanto Landgard process for the production of a low-Btu gas, and the Union Carbide Purox process for the production of a medium Btu gas are the pyrolysis installations described. (JSR)

8366 Continuous process for drying and extracting oils from solid materials. Barns, R.W. (to French Oil Mill Machinery Co.). US Patent 3,867,416. 18 Feb 1975. Filed date 31 Dec 1969. 14p.

A continuous drying and oil extraction process and apparatus is described wherein counterflow is established between successive vertical beds of stratified oil bearing particles in an extractor and ascending vapor solvent which passes upwardly through the beds agitating the particles therein to produce successive fluidized bed conditions, the vapor carrying liquids upwardly therewith to the top of the extractor. 8 claims, 4 drawing figures

8367 Production of gases. Lacey, J.A.; Phillips, T.R.; Ensell, R.L. (to British Gas Corp.). US Patent 3,915,670. 28 Oct 1975. Priority date 9 Sep 1971, United Kingdom of Great Britain and Northern Ireland (UK). 8p.

The invention is generally concerned with a process for the production of gaseous products by a chemical reaction, at least one reactant being liquid at normal temperature and pressure, which process comprises conducting the said reaction at a given pressure or a given temperature in the presence of a proportion of at least one of the reactants in the liquid phase, thereby controlling the temperature or the pressure of the reaction. The process is particularly useful for the catalytic gasification of light hydrocarbons with steam with water being present in the liquid phase, to produce a product gas which consists substantially of methane and carbon dioxide. (Official Gazette)

8368 Synthetic natural gas production. Van den Berg, G.J.; Ouwerschuur, F.K.G. (to Shell Oil Co.). US Patent 3,917,468. 4 Nov 1975. Priority date 15 Dec 1972, Netherlands. 10p.

A process for the production of synthetic natural gas or town gas is described wherein the hot gaseous product of the partial combustion of a carbonaceous fuel, containing hydrogen and carbon monoxide, is passed into a carburetting zone at a temperature of from 700 to 1100°C and therein enriched with a volatile hydrocarbon carburant which on evaporation into the hot gaseous product of partial combustion is thermally cracked into methane and lighter unsaturated hydrocarbons. The carburetted gas product is then passed into a hydrogenation zone maintained at a temperature sufficient to further decompose any remaining hydrocarbon carburant and to hydrogenate the unsaturated hydrocarbons. In this process coke formation in the carburetting zone is substantially minimized by introducing the volatile hydrocarbon carburant into the carburetting zone in the form of a thin layer of liquid which is maintained at a temperature below that at which thermal cracking occurs during the time the carburant is not adsorbed by the hot gas steam. (Official Gazette)

8369 Process for manufacturing high purity methane gas. Toida, T.; Matsuoka, S.; Yamamoto, K.; Tamura, K. (to Japan Gasoline Co., Ltd.). US Patent 3,917,467. 4 Nov 1975. Priority date 14 Jan 1971, Japan. 8p.

A process is given for manufacturing high purity methane gas by subjecting a gas mixture mainly comprising methane, hydrogen, carbon monoxide, carbon dioxide and steam to a first methanization reaction step in the presence of a nickel catalyst filled in the reaction zone to methanize a part of the carbon oxides contained therein, then subjecting the gas mixture from the first step to a carbon dioxide-absorption step to remove superfluous carbon dioxide and then subjecting the gas mixture from said absorption step to a second methanization reaction step in the presence of a nickel catalyst filled in the reaction zone to methanize the residual carbon oxides. (Official Gazette)

8370 Production of methane-rich gas. Child, E.T. (to Texaco Development Corp.). US Patent 3,922,148. 25 Nov 1975. Filed date 16 May 1974. 14p.

This is an improved continuous process for producing a clean methane-rich gas stream without the concomitant formation of particulate carbon. By-product superheated steam is simultaneously produced at a maximum temperature. The product stream may have a methane content up to 98 to 99 mole percent or higher and a gross heating value up to 1000 BTU per SCF or more. Process steps include partial oxidation of a hydrocarbonaceous fuel under operating conditions that produce a synthesis gas containing 10 to 30 mole percent methane (dry and CO_2-free basis) and a H_2/CO mole ratio of 2.6 or higher, and reacting the methane-rich process gas stream in one to three catalytic methanation stages under critical operating conditions that increase the methane content in the process gas stream stepwise up to 98 mole percent or higher. Heat from the highly exothermic methanation reaction is used to make valuable by-product superheated steam. The product gas may be burned without polluting the atmosphere. (Official Gazette)

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 8169, 8170, 8180, 8181, 8764

8371 Production of methanol. Marion, C.P. (to Texaco Development Corp.). US Patent 3,920,717. 18 Nov 1975. Filed date 26 Mar 1973. 18p.

A continuous process is given for producing methanol including the steps of producing synthesis gas i.e., $H_2 + CO$ by the partial oxidation of a hydrocarbonaceous feed in a free-flow noncatalytic synthesis gas generator, adjusting the mole ratio (H_2/CO) of the process gas stream to a value in the range of about greater than 2 to 12 by noncatalytic thermal direct water-gas shift, cooling the process gas stream by indirect heat exchange with water to produce steam for use in the process, purifying the gas stream preferably with a portion of the methanol product, catalytically reacting the purified synthesis gas stream under methanol producing conditions, and separating methanol from liquid impurities. All steps are preferably carried out at a pressure which is substantially that in the synthesis gas generator less ordinary line drop. Optionally, a portion of the liquid impurities, e.g. dimethylether, water, and mixed alcohols, are introduced into the synthesis gas generator to reduce the specific consumption of free-oxygen gas and to increase the yield of synthesis gas. (Official Gazette)

INORGANIC HYDROGEN COMPOUND FUELS

REFER ALSO TO CITATION(S) 8160

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 8250, 8365, 8822, 8850

8372 Method and apparatus for processing refuse, sewage and/or waste material into a source of energy. Jackman, V. (to John M. Fox; John V. McKeever; Harry F. Ferguson; John B. Sotak). US Patent 3,910,775. 7 Oct 1975. Filed date 22 Feb 1974. 24p.

This disclosure relates to a method and apparatus for handling refuse, using waste and treating raw sewage. The collected refuse is delivered to a receiving bin having an electrical vibrator and a power operated discharge door. The ferromagnetic articles are removed from the collected refuse by a magnetic separator. A shredder homogenizes the separated refuse, and acidic waste from a dispensing hopper is controllably mixed with the shredded refuse. The mixture of refuse and acidic waste is fed into a vertical rolling mill which dewaters and forms the refuse and waste mixture into briquettes. The briquettes from the rolling mill are dropped into a storage area which functions as a supply source from which briquettes are conveyed to a feeding trough. The briquettes of waste and refuse are controllably fed by the trough into a filtration tank to form a filtering bed. A supply conduit controllably delivers raw sewage effluence into the filtration tank so that the solids, matter in suspension and precipitates are entrapped by the filter bed medium. A level sensing device senses the amount of liquid in the tank, and a filter medium detector senses the depth of the filter bed so that expended filtering material is withdrawn from the tank by a power operated transport auger. The transport auger feeds an extruding mechanism which pelletizes the withdrawn expended filtering material. The pellets are conveyed to either a dispensing hopper or a pellet storage bin.The pellets are released from the pellet processing dispensing hopper and waste is also selectively and controllably released from the waste dispensing hopper. The mixture of pellets and waste is conveyed to the rolling mill for dewatering and for forming briquettes. The briquettes are fed to a storage area for subsequent use as a useable fuel. 32 claims, 3 drawing figures

SOLAR ENERGY

REFER ALSO TO CITATION(S) 8116, 8846

8373 Laboratory based activities in solar energy at the National Bureau of Standards. Hill, J.E. (National Bureau of Standards, Washington, DC). *ASTM Stand. News;* 3: No. 8, 20-21(Aug 1975).

A special panel was formed to assess the potential of solar energy and recommend research and development programs. The panel concluded that, with adequate research and development support, by the year 2020, solar energy could provide at least 35 percent of the heating and cooling of buildings, more than 30 percent of the methane and hydrogen needed for gaseous fuels, and greater than 20 percent of the electrical power needs. This could be done with a minimal effect on the environment and a substantial savings of nonrenewable fuels. Preliminary laboratory activities are described. (LTN)

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 8428

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 8388

8374 (ERDA/JPL—954144-75/1) **Silicon ribbon growth by a capillary action shaping technique. Quarterly technical progress report No. 1.** Schwuttke, G.H.; Ciszek, T.F.; Kran, A. (International Business Machines Corp., Hopewell Junction, N.Y. (USA). East Fishkill Lab.). Aug 1975. 96p. Dep. NTIS $5.00.

Progress during the first quarter of the contractual effort is described. The work performed relates (a) to ribbon growth by a capillary action shaping technique, (b) to ribbon characterization, and (c) to economic evaluation and computer-aided simulation of ribbon growth. Actual progress includes growth of 12-mm and 25-mm-wide ribbon with individual lengths ranging from 0.12 to 1.06 meters. The growth of silicon tubes of 6-mm diameter, 1-mm wall thickness, and more than 100-cm length was also accomplished. The "growth rate" problem of melt-grown ribbon-shaped crystals was addressed. An expression for maximum growth rate of cylindrical (Czochralski geometry) crystals and ribbon-shaped crystals was derived. Some representative values at 7.5-cm diameter or width are 45 cm/hr or 2000 cm^3/hr for a cylindrical Czochralski-grown crystal and 625 cm/hr or 95 cm^3/hr for a 0.02-cm-thick ribbon. (auth)

8375 (ERDA/JPL—954144-75/2) **Silicon ribbon growth by a capillary action shaping technique. Quarterly technical progress report No. 2.** Schwuttke, G.H.; Ciszek, T.F.; Kran, A. (International Business Machines Corp., Hopewell Junction, N.Y. (USA). East Fishkill Lab.). 1975. 79p. Dep. NTIS $5.00.

Progress during the second quarter of the contractual effort is described. The work performed related mainly to ribbon growth by a capillary action shaping technique and to ribbon characterization. Actual progress in the crystal growth area includes the evaluation of 10 potential die materials other than carbon and the process development for 25-mm-wide ribon. From the die study it is concluded that boron carbide, silicon carbide, and silicon nitride may warrant further investigation as die materials. Process development for 25-mm ribbon growth resulted in ribbons of superior surface quality. Potential ribbongrowth problems encountered and discussed include a boron doping anomaly and frozen-in stresses in ribbons. The characterization effort concentrated on the development of a solar-cell process to be used for ribbon characterization. Material requirements and detailed process procedures are given. Solar cells fabricated by this process are compared with commercially available solar cells and compare favorably. A transmission electron microscopy study of planar boundaries frequently observed in ribbon crystals is reported. (auth)

8376 (ERDA/JPL—954338-75/1) **Determination of a definition of solar grade silicon. First quarterly report, 1 October—31 December 1975.** Gutsche, H.W.; Hill, D.E. (Monsanto Research Corp., St. Peters, Mo. (USA)). 1975. Contract 954338. 30p. Dep. NTIS $4.00.

For Jet Propulsion Lab., Pasadena, CA.

The overall objective of this contract is to determine a definition of solar grade silicon by investigating the singular and the combined effect of the impurities usually found in metallurgical grade silicon on solar cell device performance. The impurity matrix was defined by Jet Propulsion Laboratory Technical Direction Memorandum. The initial work was focussed on standardizing our solar cell process and test procedure, growing baseline crystals, growing crystals "contaminated" with carbon, iron, nickel, zirconium, aluminum, and vanadium, solar blank preparation, and material characterization. The status of progress, an updated program plan, and the projected activities for the next phase of the contract are discussed. (auth)

8377 (ERDA/JPL—954339-75/1) **Evaluation of selected chemical processes for production of low-cost silicon. First quarterly progress report, October 9—December 15, 1975.** Blocher, J.M. Jr.; Browning, M.F.; Wilson, W.J.; Carmichael, D.C. (Battelle Columbus Labs., Ohio (USA)). 8 Jan 1976. 48p. Dep. NTIS $4.00.

The objective of this program is to evaluate, in the light of the latest available information and modern technology, the prospect for low cost solar silicon production by two processes which have yielded semiconductor-grade silicon commercially in the past, but whose development was curtailed by unfavorable market conditions in the early semiconductor industry. These processes are (1) zinc reduction of silicon tetrachloride and (2) thermal dissociation (or hydrogen reduction) of silicon tetraiodide. This report includes analyses of available thermodynamic data on both processes and predictions of equilibrium product yields over accessible ranges of process conditions. A parallel program of experimental work has been carried out to test the thermodynamic predictions and to evaluate process operability at several critical points. Preliminary results indicate that acceptable process yields and product structure can be obtained by zinc reduction of silicon tetrachloride in a fluidized-bed of seed particles when the zinc is fed to the bed as a vapor. Preliminary experimental results on the iodination of silicon dioxide/carbon mixtures confirm the thermodynamic predictions that temperatures in excess of 1400 C will produce potentially acceptable yields of silicon tetraiodide. (auth)

8378 (LBL—4553) **Investigation of the Cu/sub x/S/Si photovoltaic cell.** Chin, B.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-Eng-48. 49p. Dep. NTIS $4.00.

Thesis.

Cu/sub x/S/Si heterojunctions were formed in an attempt to verify reported conversion efficiencies of up to 4% for "Cu_xS"/Si photovoltaic cells. Various Cu/sub x/S/Si cells ($1.8 < x < 2.0$) were made by simultaneous vacuum deposition of copper and sulfur onto (100) single crystal silicon substrates. Since many Cu/sub x/S phases exist near the stoichiometric value, the structure of the evaporated films was determined by x-ray analysis. Spectral response measurements were made which were consistent with the x-ray results showing the presence of more than one Cu/sub x/S phase in the cells. The measured sunlight conversion efficiencies of these cells were approximately 0.25%, making them impractical for economical photovoltaic use. Reasons for the differences in conversion efficiencies are discussed. It was observed that the efficiencies slowly increased with room-temperature aging. This is explained in terms of the relaxation of lattice defects at the heterojunction interface. (auth)

8379 Charging circuit for battery-operated devices powered by solar cells. Mellors, G.W.; Powers, R.A.; Sheffield, G.W. (to Union Carbide Corp.). US Patent 3,921,049. 18 Nov 1975. Filed date 25 Sep 1973. 6p.

A charging circuit for battery-operated devices is powered by photovoltaic cells comprising a first diode means connected in parallel to a series-connected resistor and at least one photovoltaic cell, and in parallel to a series-connected second diode means and at least one secondary battery. The terminals of the components of the circuit are connected such that the current from the photovoltaic cells is limited by the first diode means so as to prevent overcharge of the secondary battery while the second diode means is connected as to prevent reverse current through the photovoltaic cells when the voltage of the secondary battery is higher than that of said photovoltaic cells. (Official Gazette)

PHOTOSYNTHETIC CONVERSION

8380 Fuel formation from aqueous ferric bromide by photolysis in the visible. Chen, S.N. (Boston Univ.); Lichtin, N.N.; Stein, G. *Science;* **190**: No. 4217, 879-880(28 Nov 1975).

Illumination of acid aqueous ferric bromide containing excess bromide yields free Br_2 and ferrous ions. The quantum yield is independent of wavelength up to about 600 nanometers, and increases with temperature; quantum yields of up to about 5 per cent $1/2Br_2$ were observed at 42°C and further improvement should be possible. Some aspects of this system for the quantum utilization of solar energy are discussed. (auth)

8381 "Synthetic leaf" mimics plants' light conversion. *Chem. Eng. News;* **54**: No. 7, 32-34(16 Feb 1976).

Recent progress in photosynthesis research at Argonne Natl. Lab. has provided new insight into the role of chlorophyll in light energy conversion. It also has provided the impetus for developing new devices for solar energy conversion. The first device to issue from the work is a "synthetic leaf", a type of photoelectric cell employing chlorophyll as the primary element. This cell is briefly discussed. (WDM)

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 8388

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 8394, 8778, 8779

TOWER FOCUS POWER PLANTS

8382 (COO—2699-1) **Heliostat array analysis. Solar power array for the concentration of energy. Technical report covering Task 4a.** Gurr, T.C.; Riaz, M. (Minnesota Univ., Minneapolis (USA). Dept. of Electrical Engineering). Nov 1975. Contract E(11-1)-2699. 140p. Dep. NTIS $6.00.

Basic physical and theoretical performance characteristics of the heliostat array of a solar-thermal power system were reviewed. The total power redirected towards a central receiver was examined. The objective of this thesis was to analyze the solar flux density distribution at the surface of a central receiver. The analysis was performed upon a vertical cylindrically shaped receiver mounted on a tower located in the center of a horizontal circular ring-shaped mirror field. The angular dimensions of this field are 30^0 and 70^0. The analysis expresses the flux density in a per-unit form and, as such, the actual height of the tower need not be considered until actual power levels are desired. (WDM)

LINEAR PARABOLIC POWER PLANTS

8383 (SAND—76-5176) **Solar total energy at Sandia Labs.** Leonard, J.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 7p. (CONF-760405—1). Dep. NTIS $3.50.

From 13. space congress; Cocoa Beach, Florida, United States of America "USA" (7 Apr 1976).

This presentation describes the Sandia Laboratories' Solar Total Energy Program. This program consists of designing, building, installing, and operating a field of concentrating parabolic trough solar collectors which provide energy at 310°C, a 32-kE/sub e/ organic Rankine cycle power plant, and the heating and cooling equipment to utilize the cascaded, low-temperature energy from the turbine/generator. Included in the presentation are descriptions of the total energy system, its components, its performance characteristics, a status report, and a discussion of future plans. (auth)

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 8844, 8847

SPACE HEATING AND AIR CONDITIONING

REFER ALSO TO CITATION(S) 8383, 8843, 8845

8384 (CONF-750879—) **CCMS solar energy pilot study solar heating and cooling systems in buildings. Report of the annual meeting, Palo Alto, California, August 4—6, 1975.** Morse, F.H.; Rose, I.B. (eds.). (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). Dec 1975. Contract AT(40-1)-4908. 153p. Dep. NTIS $6.75.

From Annual meeting of the CCMS solar energy pilot study; Palo Alto, California, United States of America "USA" (4 Aug 1975).

The objectives of the 1975 CCMS Solar Energy Pilot Study Meeting were: (1) to review the activities of the CCMS Pilot Study since the Odeillo meeting and to discuss the activities planned for the coming year; (2) to provide the participants with an up-to-date description of the status of the solar heating and cooling systems programs of the participating countries; (3) to discuss and approve the recommendations of the format committee; (4) to provide the participants with status reports on those projects for which special format reports will be prepared during the coming year; and to hear the report of the Zero Energy House Project Group and to discuss the formation of additional project groups. Countries represented at the meeting included Australia, the Bahamas, Belgium, Brazil, Canada, Denmark, El Salvador, FR of Germany, France, Greece, Israel, Italy, Jamaica, Netherlands, New Zealand, Philippines, Portugal, Saudi Arabia, Spain, Sweden, UK, UNESCO, and USA. (WDM)

8385 (ORO—4908-1) **Assist the Committee on the Challenges of Modern Society, solar heating and cooling of buildings project. Progress report, January 1, 1975—December 31, 1975.** Morse, F.H.; Allen, R.W. (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). 1975. Contract AT(40-1)-4908. 9p. Dep. NTIS $3.50.

A brief description is given of the activities of the CCMS Projects Office (Univ. of Maryland) in support of the U.S. Solar Energy Pilot Study being carried out by the Committee on the Challenges of Modern Society (CCMS) of the North Atlantic Treaty Organization. (WDM)

8386 (PB—241462) **Seminar on industrial energy conservation and seminar on solar space heating and cooling held in Seoul (Republic of Korea) on 13—15 November 1974. Staff summary report.** (Joint Continuing Committee for Scientific Cooperation (USA-South Korea)). 1975. Contract AID/CSD-2584. 28p. NTIS $3.75.

As part of the activities of the joint continuing committee for scientific cooperation, the main purpose of which is to provide recommendations on specific application of science and technology to Korea's economic and social development, the ministry of science and technology of the republic of Korea and the National Academy of Sciences sponsored two workshops on the vitally important topics of energy conservation and solar space heating and cooling. The report presents a summary of the proceedings, and includes an agenda and a list of participants. (auth)

8387 **Status report on the Sandia Laboratories solar total energy program.** Stromberg, R.P. (Sandia Labs., Albuquerque, NM). *Sol. Energy*; 17: No. 6, 359-366(1975).

A feasibility study of a combination of solar energy collection and total or cascaded energy systems has been underway at Sandia Laboratories, Albuquerque, New Mexico, since the summer of 1972. Results of the systems analysis effort have been previously reported. Systems analyses and hardware design have continued. This paper summarizes results of the program through June 1975 by providing systems analysis, design, and test data. (auth)

8388 **Solar energy: a view from an electric utility standpoint.** Spencer, D.F. (Electric Power Research Inst., Palo Alto, CA). *Trans. Am. Nucl. Soc.*; 22: 836(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

WATER HEATING

8389 (UCRL—77326) **Economics of industrial process heat from solar energy.** Dickinson, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Feb 1976. Contract W-7405-Eng-48. 11p. (CONF-760401—3). Dep. NTIS $3.50.

From ACS national meeting on thermochemical generation of H2; New York, New York, United States of America "USA" (4 Apr 1976).

The economics of supplying 50% of a company's process heat requirements by solar energy are briefly reviewed. The ERDA-SOHIO industrial process heat project is discussed in more detail. (WDM)

HEAT ENGINES

REFER ALSO TO CITATION(S) 8396, 8890

8390 **Solar energy trap.** Brantley, L.W. Jr. (to Marshall Space Flight Center). US Patent Application 518,544. 29 Oct 1974. 16p.

An apparatus is provided for trapping solar energy emitted from the Sun for heating a fluid that could be subsequently used in turbines and the like. The apparatus includes an elongated vertical light pipe having an open end through which the visible spectrum of electromagnetic radiation from the Sun passes to strike a tubular absorber carried adjacent the other end. The light pipe has a coated interior surface of a low absorptivity and a high reflectivity at the visible wave lengths and a high absorptivity/emissivity ratio at infrared wave lengths. The tubular absorber has a coating on the surface for absorbing visible wave lengths so as to heat the fluid passing through. Infrared wave lengths are radiated from the tubular absorber back into the light pipe for heating fluid passing through a tubular coil wound thereon. (NASA)

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 8390, 8845

8391 Solar energy absorber. Brantley, L.W. Jr. (to Marshall Space Flight Center). US Patent Application 518,684. 29 Oct 1974. 15p.

A solar energy absorber, including a tubular absorber surface through which a fluid passes for transferring thermal energy layer is vacuum or air for minimizing thermal energy losses through convection. A clear liquid passes between two intermediate layers of glass for transferring, by means of conduction, the thermal energy absorbed by either the initial passage of the visible spectrum of electromagnetic rays or by infrared radiation radiated from an absorber positioned below. (auth)

8392 Sun angle calculator. Flippin, A. (to Lyndon B. Johnson Space Center). US Patent Application 531,576. 11 Dec 1974. 13p.

A calculator apparatus for determining the angle of the Sun relative to the horizon at any given place and time on the Earth is described. A diagram of the calculator is provided and the method of operation is explained. The device limits the requirements for the use of solar tables and lengthy calculations involved in the present methods. (NASA)

8393 Principles of cylindrical concentrators for solar energy. Winston, R. (Univ. of Chicago); Hinterberger, H. pp 504-505 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

8394 Cost of paraboloidal collectors for solar to thermal electric conversion. Shaner, W.W. (Colorado State Univ., Ft. Collins); Wilson, H.S. *Sol. Energy;* **17**: No. 6, 351-358(1975).

Investment and other costs of paraboloidal collectors with various aperture widths, reflectivities, rim angles, and accuracies of contour and tracking are reported. In studying alternative design--cost--performance relationships, emphasis is placed on breadth of coverage rather than on detailed accuracy. Alternative aperture widths led to preferences for different production processes that are not particularly sensitive to changes in rim angle or reflectivity. Significant cost relationships in the manufacture, installation, and maintenance of collectors were found; other relationships are less certain. Besides the above, study results indicate directions for further study. (auth)

8395 Panel for selectively absorbing solar thermal energy and the method of producing said panel. Lowery, J.R. (to National Aeronautics and Space Administration). US Patent 3,920,413. 18 Nov 1975. Filed date 5 Apr 1974. 10p.

A panel for selectively absorbing solar thermal energy is comprised of a metallic substrate, a layer of bright metallic material carried on the substrate, and a solar thermal energy absorbing coating carried on the bright metallic material. A layer of zinc is interposed between the metal substrate and the layer of bright material or the metallic substrate can be anodized for receiving the layer of bright metallic material. Also disclosed is the method for producing the coating which selectively absorbs solar thermal energy. (official Gazette)

8396 Convection-type solar heating unit. Parker, L.W. US Patent 3,919,998. 18 Nov 1975. Filed date 23 Apr 1975. 10p.

A solar heater comprises a plurality of elongated containers which are nested within one another, each container having a transparent upper surface positioned to admit solar radiation to the container. Each container includes an inlet adjacent to one end thereof for the admission of a gaseous medium such as air of some other gas such as carbon dioxide, to be heated by solar radiation within the container, and further includes an outlet for the heated gaseous medium adjacent to its other end. The gas outlet of each container is connected to the inlet of the next inner one of the nested containers, and the outlet of the innermost container is connected to the inlet of the outermost container, so that the gaseous medium flows continuously to and through each of the nested containers to cause the medium to be heated to successively higher temperatures as it flows through said containers in succession. The innermost container includes a thermocouple junction, or a boiler containing water for conversion to steam by the heated gaseous medium. Plural nested-container units can be arranged in series with one another, with the respective boilers of said plural units also being connected in series, to increase the efficiency of the device. (Official Gazette)

GEOTHERMAL ENERGY

8397 (UCID—3792) **Standards for multilateral and worldwide exchange of geothermal data. Appendix I.** Herr, J.J.; Phillips, S.L.; Schwartz, S.R.; Trippe, T.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1975. 13p. Dep. NTIS $3.50.

Standards for the exchange of machine-readable data are discussed at five levels covering (1) physical characteristics of the medium used in the exchange, (2) overall structure of the data file, (3) format of individual records, (4) types of information contained in a record, (5) authority files for information definition. The standards are used by the National Geothermal Information Resource for compilations of geothermal energy data. (auth)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 8848

SITE GEOLOGY, HYDROLOGY, AND METEOROLOGY

8398 (UCID—17008) **Summary of geology at the ERDA—MAGMA—SDG and E geothermal test site.** Towse, D.F.; Palmer, T.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jan 1976. Contract W-7405-Eng-48. 8p. Dep. NTIS $3.50.

A summary is given of the geologic structure of the test facility in Imperial County. The analysis is based on well records, especially electrical logs. (LBS)

USA

8399 (TID—26985) **Geological-geophysical evaluation of the Hot Springs area, Bath County, Virginia. Progress report, June 1, 1975—February 29, 1976.** Costain, J.K. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1 Dec 1975. Contract E(40-1)-4920. 47p. Dep. NTIS $4.00.

In the northwestern part of Virginia and adjacent parts of West Virginia there are approximately 100 springs that have temperatures ranging from slightly above the mean air temperature (9 to 12°C) to about 41°C. A study was made to evaluate the geothermal resource potential of the area in the vicinity of the Warm Springs anticline in Bath and Allegheny Counties, Virginia. Phase I of the study is the compilation of a geologic map based on published maps and supported by reconnaissance and detailed geologic mapping in areas where published maps are not available. Phase II consists of a regional bipole-dipole electrical resistivity survey made in order to detect the presence of resistivity lows that might be associated with a geothermal system at depth. Phase III will include drilling a single hole to a depth of approximately 300 m with the hope of obtaining a heat flow value that is representative of the region. (LBS)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 8410

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 8399

8400 (LA—6199-MS) **Preliminary measurements of the thermal conductivity of rocks from LASL geothermal test holes GT-1 and GT-2.** Sibbitt, W.L. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-eng-36. 8p. Dep. NTIS $4.50.

The conductivities on a number of dry rocks have been measured in an air environment. These experimental values are probably about 10 percent lower than the in situ values. Initial attempts to prepare "wet" rock samples (rocks saturated with water) have so far resulted in only "damp" rocks. Considerable effort will be required to characterize the crack system in "solid" rocks and to predict the probable conductivity values for in situ conditions.

8401 (SAND—75-0608) **Report of the geophysical measurements in geothermal wells workshop, Airport Marina Hotel, Albuquerque, New Mexico, September 17—19, 1975.** Baker, L.E.;

Baker, R.P.; Hughen, R.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 68p. Dep. NTIS $4.50.

This report presents results of a Workshop on Geophysical Measurements in Geothermal Wells, hosted in Albuquerque, September 17-19, by Sandia Laboratories and jointly sponsored by the United States Geological Survey and the Energy Research and Development Administration. During the workshop, tutorial papers dealing with the geothermal resource, geothermal logging, and high temperature technology were followed by working panel sessions. Three panels deliberated, respectively, well and reservoir parameters, log interpretation, and high temperature technology. In a final session, the reports of the panels were heard and discussed by the full workshop. A summary of the workshop conclusions and recommendations, as well as the complete panel statements, are presented. (auth)

GEOCHEMICAL TECHNIQUES AND SURVEYS

8402 (LBL—4422) **Sampling hot springs for radioactive and trace elements.** Wollenberg, H.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-eng-48. 24p. (CONF-751086—3). Dep. NTIS $3.50.

From Workshop on sampling geothermal effluents; Las Vegas, Nevada, United States of America "USA" (20 Oct 1975).

A brief description is given of techniques that have proved successful in obtaining samples of hot and cold spring waters for x-ray fluorescence, neutron activation, and radiometric analysis. The sampling methods require only lightweight, portable field apparatus. Various types of springs sampled are illustrated. Chemical geothermometer temperatures from these samples have compared well with reported measured subsurface temperatures. (LBS)

EXPLORATORY DRILLING

REFER ALSO TO CITATION(S) 8398

REGULATIONS

REFER ALSO TO CITATION(S) 8849

ECONOMICS

REFER ALSO TO CITATION(S) 8405

GEOTHERMAL POWER PLANTS

DESIGN AND OPERATION

8403 (ANCR—1245) **Analysis of the binary cycle for geothermal power generation.** Madsen, W.W.; Ingvarsson, I.J. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Dec 1975. Contract E(10-1)-1375. 97p. Dep. NTIS $6.00.

Exchanging heat from hot geothermal fluid to a secondary working fluid which is then expanded through a turbine appears to be the best way of producing electrical power from a medium temperature geothermal resource. A study has been made to determine the conceptual design state points for a dual boiling system which utilizes isobutane as the working fluid. The results of this work and the sensitivity of plant performance to variations from nominal design points are presented. In addition, variations due to tolerances applied to thermodynamic properties and other key factors are included. (auth)

8404 **Analysis of geothermal power plant water using gamma rays from capture of ^{252}Cu neutrons.** Duffey, D. (Univ. of Maryland, College Park); Balogna, J.P.; Wiggins, P.F. *Nucl. Technol.*; 27: No. 3, 488-499(Nov 1975).

The geothermal power effort to extract energy from hot dry rock will require careful water analysis to assist in plant control, to monitor corrosion and solid deposition, and perhaps to recover byproduct minerals. To demonstrate laboratory techniques and indicate plant feasibility, geothermal waters frm the Valle Grande Caldera near Jemez Springs, New Mexico were irradiated in laboratory assemblies with neutrons from a ^{252}Cf source and the high-energy capture gamma rays were measured. The results indicate that chlorine, sodium, calcium, and silicon (and probably other trace elements) can be determined and can help evaluate a geothermal area for power. Such nondestructive analytical techniques applied on-line in the plant, and, depending on neutrons and high-energy gamma rays penetrating thick metal pipes holding the water, should prove useful in the operational needs of the power plant. (auth)

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 8890

8405 (ANCR—1226) **Conceptual design and cost evaluation of organic Rankine cycle electric generating plant powered by medium temperature geothermal water.** Dart, R.H.; Neill, D.T.; Whitbeck, J.F. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Dec 1975. Contract E(10-1)-1375. 80p. Dep. NTIS $6.00.

The economic production of electrical power from high temperature steam and liquid dominated geothermal resources has been demonstrated. Large quantities of geothermal energy are considered to exist at moderate temperatures, however, the economics of converting this energy into electricity has not been established. This paper presents the design concept of a dual boiler isobutane cycle selected for use with the moderate temperature hydrothermal resource and presents a cost estimate for a 10 and 50 MW power plant. Cost of electrical power from these plants is estimated and compared with that from coal, oil and nuclear plants. The impact of selling a portion of the residual heat in the geothermal effluent is assessed. (auth)

8406 (ORNL-MIT—180) **Choice of working fluid and operating conditions for energy conversion with geothermal heat sources.** Landgraf, K.R.; Kudrnac, K.I.; Solares, R. (Oak Ridge National Lab., Tenn. (USA)). 23 Oct 1973. 68p. Dep. NTIS $4.50.

A study of electric power generating cycles which can be used in conjunction with a low-temperature geothermal energy (sensible heat) source is presented. Investigators at Los Alamos Scientific Laboratory have proposed a steam/isobutane dual cycle capable of generating 50.7 Mw of electric power. This cycle is optimized using regenerative feed water heating to yield a power output of 52.1 Mw or an improvement of 2.8%. Other power cycle designs and working fluids are investigated. Working fluids including various freons, steam, isobutane, ammonia, SO_2, CO_2, and several low molecular weight alkanes and alkenes are considered. The power cycle designs which are investigated include single and dual Rankine cycles (some of which involve regenerative feed heating), as well as topping/bottoming Rankine cycles, and Brayton gas cycles. The investigation shows that use of a single freon-11 cycle results in a 57.7 Mw power output representing an improvement of 13.8% over the LASL proposal. This cycle represents the best performance of all the combinations investigated, although several other cycles exhibit performance superior to that of the LASL proposal. It is recommended that the freon-11 single cycle be considered on an economic basis as a replacement for the steam/isobutane cycle in the proposed LASL system. Furthermore, it is recommended that several new freon working fluids beinvestigated for which thermodynamic data were not available at this time. (auth)

GEOTHERMAL ENGINEERING

FLUID TRANSMISSION

REFER ALSO TO CITATION(S) 8409

CORROSION AND SCALING

REFER ALSO TO CITATION(S) 8404

8407 (UCRL—51977) **Possibilities for controlling heavy metal sulfides in scale from geothermal brines.** Jackson, D.D.; Hill, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jan 1976. Contract W-7405-Eng-48. 17p. Dep. NTIS $3.50.

Heavy metal sulfides form a substantial part of the scale solids depositing from high-temperature, high-saline geothermal brines. An assessment has been made of the prospects for controlling this deposition by chemical modification of the brine. An outline is given of the types of reactions influencing sulfide precipitation. It is suggested that two factors affecting sulfide solubility and that are amenable to chemical modification of the brine are oxidation state and pH. A partial oxidation process can be used to convert aqueous sulfide species to free sulfur, a process favored by thermodynamics and kinetics. Some oxidizing agents

are suggested for this purpose. A discussion is given of the possibilities of precipitating other solid phases after extensive oxidation. It is concluded on the basis of the available data that this possibility exists, but that uncertainties in reaction kinetics, unavailable data, and solution complexity make an exact analysis difficult. The usefulness of a field evaluation of chemical modification processes is indicated. (auth)

WELL PERFORMANCE

REFER ALSO TO CITATION(S) 8414

8408 (LA-UR—75-2335) **Some problems involved with sampling geothermal sources.** Stoker, A.K.; Purtymun, W.D. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-Eng-36. 31p. (CONF-751086—2). Dep. NTIS $4.00.

From Workshop on sampling geothermal effluents; Las Vegas, Nevada, United States of America "USA" (20 Oct 1975).

Geothermal wells must be sampled for a variety of purposes including geologic and geochemical interpretation, engineering design of facilities, environmental release evaluation, and documentation of baseline conditions. Basic factors influencing the choice and application of sampling methods are reviewed including the type of the geothermal resource, the analyses of interest, well production parameters, utilization processes, and possible sample contamination or instability. Three basic methods of sampling are described including condensation, phase separation, and use of evacuated containers. Several practical problems experienced by various workers are discussed. These include the natural variability of fluid composition with time, effects of well-bore heat losses, effects of well flow rate and production time, sampling locations, laboratory simulation studies, contamination by corrosion reactions, and documentation of hydrologic systems possibly connected to the geothermal resource. (auth)

8409 (UCRL—77544) **Sampling a two-phase geothermal brine flow for chemical analysis.** Hill, J.H.; Morris, C.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Dec 1975. Contract W-7405-Eng-48. 27p. (CONF-751086—1). Dep. NTIS $4.00.

From Workshop on sampling geothermal effluents; Las Vegas, Nevada, United States of America "USA" (20 Oct 1975).

An experiment designed primarily to define the problems associated with sampling the two-phase flow in a pipeline of geothermal brine is described. Analyses reported for 26 samples include chemical composition, oxidation potential, pH, density, and total solids. Changes in brine composition as the well operated during a four-week period are evaluated. The apparatus and techniques used for sampling are described and evaluated. (auth)

ARTIFICIAL STIMULATION

8410 (LA—6080-PR) **Solid earth geosciences research activities at LASL. Progress report, January 1—June 30, 1975.** Heiken, G. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 15p. Dep. NTIS $4.50.

The geoscience group at the Los Alamos Scientific Laboratory (LASL) supports existing geoscience-related programs and conducts a basic research program related to energy and earth resources. Projects supporting the dry hot-rock geothermal energy program include study of drill cores, seismic activity associated with hydraulic fracturing at the drill site, and the thermal state of the Valles Caldera. Research in igneous processes includes the modeling of large-scale volcanic eruptions such as the one which deposited the Bandelier Tuff around the Jemez Mountains, the petrology of those tuffs, and the dimensions of the magma chamber below the Valles Caldera. Recent activity at Mt. Baker, WA, presented an opportunity to observe increasing fumarolic activity which may precede an eruption. The activity is continuously monitored by two sequence cameras. Samples of the tephra from around the vent have been studied, temperatures were measured, and ground observations were made of the new fumaroles. Every three months a flight is made over the volcano for aerial photography and infrared scanning. Field studies in the Southern Cascade Mountains were begun to determine the petrochemistry, mode of eruption, and volume of erupted materials for the last 0.5 million years. This study will be used to evaluate the present thermal state and composition of magmas below the range. Investigations ofactive volcanoes and their eruptions will provide data for geothermal research on the physical properties of the magma. (auth)

8411 (LA—6148-MS) **Application of stress corrosion to geothermal reservoirs.** Demarest, H.H. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-eng-36. 4p. Dep. NTIS $4.50.

There are several alternative equations which describe slow crack growth by stress corrosion. Presently available data suggest that an alternative form may be preferable to the form which is most often used, but the issue cannot be clearly decided. Presently available stress corrosion data on glasses and ceramics suggest that rocks in a proposed geothermal reservoir will crack readily over long time periods, thus seriously limiting the operation of this type of power source. However, in situ hydrofracturing measurements together with a theoretical treatment suggest that such a reservoir will contain a relatively high pressure over a long period of time without further cracking. Further experimentation is desirable to measure directly the critical stresses for crack growth rates on the order of 10^{-7} m/sec.

8412 (LA—6169-MS) **Determination of permeability of granitic rocks in GT-2 from hydraulic fracturing data.** Delisle, G. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 5p. Dep. NTIS $4.50.

The Los Alamos Scientific Laboratory is currently conducting a study to determine the feasibility to extract geothermal energy from dry hot rock. The investigated concept calls for the creation of a hydraulic fracture in hot, impermeable rock. Heat will be exchanged subsequently at the fracture surface between the rock and a circulating fluid. The successful creation of hydraulic fractures in the granitic section of exploratory holes GT-1 and GT-2 yielded sufficient data to calculate the average permeability of the rock next to a fracture by means of the mathematical model. The calculated permeabilities were found to be in the microdarcy range and proved the granitic rock penetrated by GT-1 and GT-2 to be sufficiently impermeable to test the above concept. (auth)

8413 (LA—6175-MS) **Angle of crack propagation for a vertical hydraulic fracture.** Sarda, J.P.; Hsu, Y.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-eng-36. 6p. Dep. NTIS $4.50.

Using the strain-energy-density-factor (S) theory, the positive fracture angle +theta/sub o/ (the initial fracture angle of crack propagation) of a near-vertical crack is predicted by using the opening- and sliding-mode stress-intensity factors in the presence of the overburden pressure, the least in situ horizontal principal stress, and the borehole fluid pressure. The crack spreads in the positive theta/sub o/ direction (counter-clockwise) in the plane for which S is a minimum, S/sub min/. It was verified that S/sub min/ is greater than or equal to S/sub c/. The quantity S/sub c/ is defined as the critical value of S, and remains essentially constant. Of interest is the numerical example for calculating fracture angle and the critical uniform borehole fluid pressure required to initiate fracture at such an angle for the present LASL Dry Hot Rock Geothermal Energy Program. (auth)

8414 (PB—239718) **Stimulation and reservoir engineering of geothermal resources. Progress report No. 3.** Kruger, P.; Ramey, H.J. Jr. (Stanford Univ., Calif. (USA)). Jun 1974. 149p. (SGP-TR—1). NTIS $5.75.

The broad objectives of this program have been: (1) development of experimental and computational data to evaluate the optimum performance of fracture-stimulated geothermal reservoirs; (2) the development of a geothermal reservoir model to evaluate important thermophysical, hydrodynamic, and chemical parameters based on fluid-energy-volume balances as part of standard reservoir engineering practice; and (3) construction of a laboratory model of an explosion-product chimney to obtain experimental data on the processes of in-place boiling, moving flash fronts, and two-phase flow in porous and fracture hydrothermal reservoirs. (GRA)

8415 (UCRL—77637) **Predicting explosion-generated permeability around geothermal wells.** McKee, C.R.; Hanson, M.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jan 1976. Contract W-7405-eng-48. 11p. (CONF-751224—1). Dep. NTIS $3.50.

From Workshop on geothermal reservoir engineering; Stanford, California, United States of America "USA" (15 Dec 1975).

A theoretical expression showing the radial dependence of permeability in geologic media as a function of the distance from the point of detonation has been derived. This relationship shows that created permeability decreases as a function of radius ($1/r^5$ around a spherical blast and $1/r^4$ around a cylindrical shot). Excellent correlation was found when this prediction was compared with permeability measurements made around the site of the Hardhat nuclear event fired in granodiorite and a chemical explosive detonated in coal. (auth)

ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 10055

GEOTHERMAL DATA AND THEORY

REFER ALSO TO CITATION(S) 8410

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 8400, 8412

WIND ENERGY

REFER ALSO TO CITATION(S) 8844

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 8426, 8439, 8449, 8450

8416 (NSF/RA/N—74-127) **Wind power potential of Alaska. Part I. Surface wind data from specific coastal sites.** Wentink, T. Jr. (Alaska Univ., College (USA). Geophysical Inst.). Aug 1974. 122p.

Emphasis on characterization of the wind regimes as they may apply to the design and installation of windmills for power generation at specific sites in Alaska is studied. Empirical and analytical formulae for the velocity duration curves are covered in the text, and in an appendix. The results from these have strong implications for improved simplified wind data gathering systems, especially for large area surveys and from automatic unmanned stations. 13 references (auth, from Summary)

8417 (NSF-RA-N—75-050, pp 92-97) **Operational, cost and technical study of large windpower systems integrated with existing public utilities.** Swanson, R.K.; Smith, R.T.; Johnson, C.C. (Southwest Research Inst., San Antonio). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The potential, the promising deployment schemes, the cost goals, and the research problems inherent in the large scale implementation of wind energy conversion systems in the Texas Panhandle are analyzed. The methodology to be developed during the program is expected to be easily transferable to other utility systems of interest. (auth)

8418 (NSF-RA-N—75-050, pp 112-120) **Wind system research project for the City of Hart, Michigan.** Asmussen, J. Jr. (Michigan State Univ., East Lansing). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The entry of wind power technology into practical application in scale, time and space in small municipal utilities and REA systems is analyzed. In particular, an initial assessment of the technical and economic feasibility of applying wind energy conversion technology to satisfy the electrical power needs of the City of Hart, Michigan is conducted. Historical wind data as well as present (1975) wind information from nearby Coast Guard Stations are analyzed. Three permanent wind measuring stations and a portable wind measuring facility will be employed to define the wind energy potential of the Hart area and will aid in the determination of prospective wind turbine sites. (auth)

8419 (NSF-RA-N—75-050, pp 121-129) **Summary of Alaskan wind power and its possible applications.** Wentink, T. Jr. (Univ. of Alaska, Fairbanks). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The potential and possible applications of Alaskan wind power are examined. Wind data are collected at selected sites, and climatological, logistical and operational problems are identified. Alternative possible uses of wind derived power are compared. (auth)

8420 (NSF-RA-N—75-050, pp 319-325) **Wind climatology.** Reed, J.W. (Sandia Labs., Albuquerque, NM). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

National assessments were made to find suitable test and evaluation locations. Detailed analyses have begun of specific station records to derive parametric relationships needed for turbine design. Characteristics of long wind-speed time-series will determine selection criteria for cut-in, cut-off, and rated speed, as well as storage system dimensions. (auth)

8421 (NSF-RA-N—75-050, pp 326-335) **Initial wind energy data assessment study.** Changery, M. (National Climatic Center, Asheville, NC). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A search of the data files maintained at the National Climatic Center was undertaken to determine the availability of meteorological data required for the design, construction and siting of wind turbine equipment. The purpose of the survey is to provide a comprehensive report on the availability of data and summarizations of land and marine surface wind measurements, upper level wind measurements, gusts, turbulence, inversions, icing and tower data. The results of the wind data survey are presented. (auth)

8422 (NSF-RA-N—75-050, pp 336-340) **Wind characteristics and wind power generation: a three year meteorological program in Sweden.** Olsson, L.E. (Univ. of Stockholm); Holme, O.; Kreig, R. Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A three year program for studies of meteorological aspects of wind power has been initiated in Sweden. The objective of the program is to provide a scientific base for evaluating the potential for wind energy conversion in Sweden. This includes preparation of meteorological-aerodynamic base-material for construction and site evaluation as well as studies of alternative optimal groupings and performance characteristics of various wind energy conversion systems to be used in a local, regional and national scale. (auth)

8423 (NSF-RA-N—75-050, pp 353-355) **Locating areas of high wind energy potential by erts observations of aeolian geomorphology.** Marwitz, J.; Marrs, R. (Univ. of Wyoming, Laramie). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The objective of the research is to test whether ERTS observations of aeolian geomorphology features can be used to locate areas of favorable wind energy conversion sites. This is a one year project funded by NSF/RANN and began in March 1975. (auth)

8424 (NSF-RA-N—75-050, pp 360-366) **Annual power output potential for 100;-kW and 1-MW aerogenerators.** Justus, C.G. (Georgia Inst. of Tech., Atlanta). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

Previous estimates of wind power potential in the U.S. have been based on statistics of the mean wind speed at various sites across the country. While the average power output of a wind generator will certainly depend on the mean wind speed, it will also have a dependence on other factors, e.g., variance of wind speed about the mean. A method for computing actual expected output power from a wind generator, given the observed wind speed distribution, and results of application of this method, in the form of aerogenerator plant factor (ratio of average power output to rated power) for the continental U.S. are presented. Plant factors are evaluated for aerogenerators with characteristics of NASA's 100-kW Plumbrook unit and the design characteristics of NASA's 1-MW aerogenerator. 5 references. (auth)

8425 (NSF-RA-N—75-050, pp 367-371) **Wind velocity as modified by geomorphology.** Duchon, C.E. (Univ. of Oklahoma, Norman). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

Electrical energy from the wind will be extracted from the planetary boundary layer. This layer varies in depth from 100m to 1000m above the surface and exists because of the frictional drag of the earth's surface. Surface heating coupled with the topog-

raphy and vegetation cause this layer to exhibit spatial and temporal gradients of the vector wind greater than anywhere else in the atmosphere. The empirical relationships of the wind speed and wind direction in the atmospheric boundary layer to underlying terrain and the surface geostrophic wind are analyzed. The terrain under consideration would show significant relief on the horizontal scale of about 100 meters to a few kilometers, but insignificant change in surface vegetation. (auth)

ECONOMICS

REFER ALSO TO CITATION(S) 8433, 8443

8426 (NSF-RA-N—75-050, pp 98-103) **Application of wind power systems to the service area of the Minnesota Power and Light Company.** Lindquist, O.H. (Honeywell Inc., Minneapolis). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The objective of Honeywell's study is to define the attributes and performance requirements of a system capable of yielding a satisfactory return on investment to a utility company. An initial system definition will be developed by designing and evaluating the most cost-effective system based on available wind information and today's technology. The system will be tailored to the Minnesota Power and Light (MP&L) Company region. Within MP&L's region is located a sparsely populated, high-wind-energy area that could be used to alleviate the load problems caused by a fast-growing taconite industry. In addition, the nation's highest utility load factor and operational flexibility derived from having significant hydro and high voltage d-c sources place MP&L in an ideal position to accept the output expected from wind power systems. (auth)

8427 (NSF-RA-N—75-050, pp 167-172) **Translation from the Danish: windpower.** Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The economic aspects of utilizing wind turbine generators in Denmark are analyzed. (DCC)

8428 (PB—239272) **Development of an electrical generator and electrolysis cell for a wind energy conversion system. Progress report.** Hughes, W.; Allison, H.J.; Ramakumar, R.G. (Oklahoma State Univ., Stillwater (USA)). 15 Oct 1974. 127p. NTIS $5.75.

Included are reports on the following topics: economical and technical aspects of wind generation systems; economics of solar and wind energy systems for large scale power generation; economical prospects for large scale utilization of solar and wind energy; and operation of parallel-bridge rectifier systems with capacitors at bridge-inputs. (GRA)

8429 (N—75-10587) **Economics of using wind power for electricity supply in the Netherlands and for water supply on Curacao.** Vermeulen, H. Oct 1974. Translation of TW—555 and Gcv-R—128. (NASA-TT-F—15982). 64p. NTIS $4.25.

It is shown to be economically feasible to harness the wind for electricity supply in the Netherlands in terms of power and production costs. Different wind power plants are discussed in detail. An abridged account of a Danish proposal to harness wind power, and calculation of the efficiency Danish aeromotor are included. Comparisons are made with the power need situation in Curacao, and it is determined that a similar wind power conversion capability recommended for the Netherlands is feasible for the West Indies as well. (auth) (GRA)

8430 (N—75-13385) **Exploiting wind power for the production of electricity.** Johansson, M. Dec 1974. Translation of TR—152. (NASA-TT-F—16058). 55p. NTIS $4.25.

The economic, energy-economic, and environmental issues involved in any prospective exploitation of wind power intended to cover a minor part (10 percent) of Denmark's consumption of electricity are discussed. The chief basis for the calculations involved is the 200 kW experimental windmill built at Gedser in 1956-57, which ceased to produce electricity in 1967. However, in exploring the ramifications of making Denmark partially dependent on wind energy power, estimates are made on the basis of projected larger series of mills of the Gedser type. Wind mill projects abroad, such as at Vattenfall, NSF and NASA, are also discussed, as is Denmark's dependence on power from Sweden and Germany. (auth) (GRA)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8430

WIND ENERGY ENGINEERING

APPLICATIONS

8431 (NSF-RA-N—75-050, pp 104-111) **Wind machines for the California Aqueduct.** Lindley, C.A. (Aerospace Corp., El Segundo, CA). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The use of wind turbine generators to provide some of the electric power needed for the California Aqueduct pumping systems is analyzed. (DCC)

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 8429

8432 (N—74-16757, pp 80-88) **Rotor dynamic considerations for large wind power generator systems.** Ormiston, R.A. (U.S. Army Air Mobility R and D Lab., Moffett Field, CA). Dec 1973.

From Proceedings on wind energy conversion systems; Washington, District of Columbia, USA (11 Jun 1973).

In Wind energy conversion systems.

NONE

8433 (N—75-13380) **Wind energy developments in the 20th Century.** Vargo, D.J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1974. 29p. (NASA-TM-X—71634; E—8172). NTIS $3.75.

Wind turbine systems of the past are reviewed and wind energy is reexamined as a future source of power. Various phases and objectives of the Wind Energy Program are discussed. Conclusions indicate that wind generated energy must be considered economically competitive with other power production methods. (GRA)

8434 (N—75-17712) **Structural analysis of wind turbine rotors for NSF-NASA MOD-0 wind power system.** Spera, D.A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Mar 1975. 39p. (NASA-TM-X—3198; E—8133). NTIS $3.75.

Preliminary estimates of vibratory loads and stresses in hingeless and teetering rotors for the proposed 100-kW wind power system are presented. Stresses in the shank areas of the 19-m (62.5-ft) blades are given for static, rated, and overload conditions. The teetering rotor has substantial advantages over the hingeless rotor with respect to shank stresses, fatigue life, and tower loading. A teetering rotor will probably be required in order to achieve a long service life in a large wind turbine exposed to periodic overload conditions. (auth) (GRA)

8435 (N—75-17786) **Wind power machines.** Hutter, U. Feb 1975. Translated from pp 1030-1044 of Huette, des Ingenieurs Taschenbuch, Wilhelm Ernst and Son, Berlin, 1954. (NASA-TT-F—16195). 26p. NTIS $3.75.

Basic aerodynamic features of wind power and wind wheels are discussed. The adaptation of wind power to running machinery is described. Developments in wind power are illustrated, followed by a brief outline of operating properties. (auth) (GRA)

8436 (NSF/RA/N—74-091) **Optimization and characteristics of a sailwing windmill rotor. Semiannual progress report, February 15, 1974—June 30, 1974.** Sweeney, T.E. (Princeton Univ., N.J. (USA). Dept. of Aerospace and Mechanical Sciences). Jul 1974. 34p.

An adequate number of center body ratios (body diameter/rotor diameter) have been tested in the Princeton 2 foot x 3 foot wind tunnel to determine the optimum value of this geometric parameter. A series of experiments defining the effect of various diameters of center discs and completely streamlined center bodies are described. During this reporting period the 25 foot diameter Princeton Sailwing Windmill was disassembled, fitted with new 4.5 oz. Dacron sails, a brake and a strain gage torque bridge. The calibration of the site has been completed and preliminary power tests begun. An extensive literature review of windmill publications is included. (auth)

8437 (NSF/RA/N—74-113) **Applied aerodynamics of wind power machines.** Wilson, R.E.; Lissaman, P.B.S. (Oregon State Univ., Corvallis (USA)). May 1974. 106p.

The aerodynamics of various types of wind power machines and advantages and disadvantages of various schemes for obtaining power from the wind are discussed. Simple, one-dimensional models for various power producing machines are given along with their performance characteristics and presented as a function of their elementary aerodynamic and kinematic characteristics. Propeller type wind turbine theory is reviewed to level of strip theory including both induced axial and tangential velocities. (auth, from Introduction)

8438 (NSF/RA/N—74-142) **Development of an electrical generator and electrolysis cell for a wind energy conversion system. Progress report [for] period ending September 30, 1974.** Hughes, W.L.; Allison, H.J.; Ramakumar, R.G. (Oklahoma State Univ., Stillwater (USA)). 15 Oct 1974. 123p.

This project for NSF-RANN has three objectives. The first objective is to design, build, and experimentally operate a high pressure, moderate temperature electrolysis system. This objective is to include work on electrode design, efficiency improvement and is to develop techniques for valving gases out of the system. The second objective of this project is to design and fabricate a field modulated generation system suitable for operation with an aeroturbine in the 10 - 20 kW level. In addition, it is proposed to investigate the possibility of improving the magnetic circuit design in Field Modulated Generation Systems. The details of this development are given. The third objective is to construct, debug, and gain significant operational experience on a "windmill farm." In this system, multiple wind turbines are erected, each driving a field modulated alternator. Construction of the pilot system is now completed at a site on the Stillwater Municipal Airport. Details are given. (auth, from Summary Introduction)

8439 (NSF-RA-N—75-050) **Proceedings of the second workshop on wind energy conversion systems, Washington, D.C., June 9—11, 1975.** Eldridge, F.R. (ed.). (Mitre Corp., McLean, Va. (USA)). Sep 1975. 601p. (CONF-750615—; MTR—6970). Dep. NTIS $17.25.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

Separate abstracts are presented for 45 papers concerning wind turbines, power conversion systems, and climatology. (DCC)

8440 (NSF-RA-N—75-050, pp 13-20) **Introduction to large system design.** Thomas, R.L. (Lewis Research Center, Cleveland). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

Design problems associated with large wind turbine generator systems are discussed. The development schedule in the U.S. for large wind turbine generator systems is presented. (DCC)

8441 (NSF-RA-N—75-050, pp 21-36) **Status of 100 kW experimental wind turbine generator project.** Puthoff, R.L. (Lewis Research Center, Cleveland). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The Energy Research and Development Administration and the NASA Lewis Research Center have engaged jointly in a Wind Energy Program which includes the design and erection of a 100 kW wind turbine generator. This test machine consists of a rotor turbine, transmission, shaft, alternator, and tower. The rotor, measuring 125 feet in diameter and consisting of two variable pitch blades, operates at 40 rpm and generates 100 kW of electrical power at a wind velocity of 18 mph. The entire assembly is placed on top of a tower 100 feet above ground level. The machine is currently in the assembly phase and will be ready for operation in August, 1975. (auth)

8442 (NSF-RA-N—75-050, pp 37-45) **G.E. systems studies of large-scale WECS.** Killen, R. (General Electric Co., Philadelphia). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The cost of generating electrical power by wind turbine generator systems is analyzed for different wind regions. Minimum cost systems are discussed. Various system configurations are studied. (DCC)

8443 (NSF-RA-N—75-050, pp 46-58) **Concept selection, optimization, and preliminary design of large wind generators.** Meier, R.C. (Kaman Aerospace Corp., Bloomfield, CT). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A preliminary design of a large wind generator system for use by electric utilities is described. The conceptual design task covered the examination of a number of suitable WGS candidate concepts, an evaluation of three of the most promising of these concepts, and the selection of the system concept which appeared to be most suitable for the utility application. The parametric analysis covered the development of a computer program capable of optimizing the system and its components, and the system optimization. The applications and requirements analysis identified the specific utility interface requirements of a WGS in a standard electric utility application, and estimated the cost goals necessary for the system to be competitive with conventional generation equipment. These three initial tasks have been completed, and the results are presented. (auth)

8444 (NSF-RA-N—75-050, pp 130-132) **Potential of WECS for Hawaii.** Grace, D.J. (Univ. of Hawaii, Honolulu). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

Research programs for the development and use of wind turbine generators in Hawaii are reviewed. (DCC)

8445 (NSF-RA-N—75-050, pp 133-139) **Wind power in Britain; past work and present position.** Stodhart, A.H. (The Electrical Research Association Ltd., Leatherhead, Eng). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The development program for wind turbine generators in the United Kingdom is reviewed. (DCC)

8446 (NSF-RA-N—75-050, pp 140-148) **Swedish wind energy program, a three year R and D plan 1975—1977.** Ljungstroem, O. (STU, The National Swedish Board for Technical Development, Stockholm). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A first phase of a three year program was started by the National Swedish Board for Technical Development (STU) in January of 1975, and it is expected that the STU-proposed program will be carried on to form a basis for decision as regards implementation of large scale wind energy systems in the late 1980s. The main features of the STU WECS-program, its background and achievements to date are described. (auth)

8447 (NSF-RA-N—75-050, pp 149-155) **Israeli work on aerogenerator shrouds.** Igra, O. (Ben Gurion Univ. of Negev, Israel). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

Past work in Israel has shown that wind turbines enclosed in specially designed shrouds can increase the output of power of the turbine by a factor of 3 or so, as compared with unshrouded turbines under the same free wind stream conditions. However, first generation shrouds were found to be unacceptable for economical use, i.e., the ratio of the shroud's total length to throat diameter was of the order of 7. The main purpose of the present work was to arrive at a compact shroud configuration, without sacrificing aerodynamic performance. The results clearly indicate that it is possible to obtain shrouds with a total length to throat diameter ratio that is smaller than 3, and that have an aerodynamic performance similar to the first-generation model. 15 references. (auth)

8448 (NSF-RA-N—75-050, pp 156-161) **Comparison of wind turbine generators.** Westh, H.C. (F.L. Smidth and Co. A/S, Copenhagen). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The "Comparative Table" contains some information about Danish propeller-driven, high-speed, 50-200 kW wind turbine generators which were in service during the period 1940 to 1968; and for the sake of comparison, some informative data regarding two actual NASA WTG-projects are also quoted in the table. (auth)

8449 (NSF-RA-N—75-050, pp 173-181) **French investigations on large wind generators, including different types of machines and studies of sites.** Argand, A. (Electricite de France, Chatou, France). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A review of the French research and development program on large wind turbine generators is presented. The availability of wind in France for use by wind turbines is discussed. (DCC)

8450 (NSF-RA-N—75-050, pp 182-187) **Canadian wind energy program.** Templin, R.J. (National Research Council, Ottawa). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The Canadian research and development program for vertical axis wind turbine generators is described. The wind availability in Canada is discussed. (DCC)

8451 (NSF-RA-N—75-050, pp 188-195) **Wind energy research in the Netherlands.** Pelser, J. (Reactor Centrum Nederland Petten). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The research and development programs for wind turbine generators in the Netherlands are reviewed. 11 references. (DCC)

8452 (NSF-RA-N—75-050, pp 202-207) **Current problems in performance modelling.** Wilson, R.E. Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

Work on the Applied Aerodynamics of Wind Power Machines has been sponsored by NSF/RANN Grant GI-41840 and has resulted in the publication of a monograph by Wilson and Lissaman. The present status of performance analysis for horizontal axis rotors is summarized. (auth)

8453 (NSF-RA-N—75-050, pp 208-223) **100-kW hingeless metal wind turbine blade design, analysis and fabrication considerations.** Donham, R.E. (Lockheed-California Co., Burbank). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The NASA-LeRC wind energy program includes the design and operation of a 100-kW experimental wind turbine generator (WTG) to be used to provide an engineering data base and to evaluate candidate components and subsystems. The Lockheed-California Company has the contract (NAS3-19235) to design and build blades for the 100-kW WTG rotor. This contract provides for design, analysis, fabrication, instrumentation, and shake testing of three blades (set of 2, one spare). A flow diagram showing how the design/fabrication of blades for the 100 kW WTG fits into the wind energy research program is given. 9 references. (auth)

8454 (NSF-RA-N—75-050, pp 224-228) **Sailwing windmill technology.** Sweeney, T.E. (Princeton Univ., NJ). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The major objective of the Princeton Windmill Program is easily stated. This is to understand the aerodynamics of a windmilling rotor and the effect of geometry upon the efficiency of such a device. Basically the chore has been to determine the optimum blade planform, blade twist and pitch angle. All work (other than small scale) has utilized the Princeton Sailwing largely because it is most easily changed in twist. It is also most simple and inexpensive to construct. A parallel program, utilizing small scale wind tunnel models, has enabled the pursuit of a second objective of determining the effect of center bodies upon the efficiency of a windmilling rotor. (auth)

8455 (NSF-RA-N—75-050, pp 229-233) **Nonpotential aerodynamics for windmills in shear-winds.** Morino, L. (Boston Univ., MA). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A new formulation is presented for nonpotential (viscous and inviscid) tridimensional incompressible aerodynamic flow, with application to windmills in shear winds. 8 references. (auth)

8456 (NSF-RA-N—75-050, pp 239-246) **Experimental and analytical research on the aerodynamics of wind turbines.** Rohrbach, C. (Hamilton Standard, Windsor Locks, CT). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

This aerodynamic research program is aimed at providing a reliable, comprehensive data bank on a series of wind turbines covering a broad range of prime aerodynamic and geometric shape variables. Such data obtained under controlled laboratory conditions on turbines designed by the same method, of the same size, and tested in the same wind tunnel are currently not available in the literature. Moreover, this research program is further aimed at providing a basis for evaluating the adequacy of existing wind turbine aerodynamic design methodology, for assessing the potential of recent, advanced theories, and for indicating the need for further method development and refinement. (auth)

8457 (NSF-RA-N—75-050, pp 249-255) **Composite bearingless rotor control concepts for wind turbines.** Cheney, M.C. Jr. (United Technologies Research Center, East Hartford). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The objective of this research program is to evaluate the potential benefits the Composite Bearingless Rotor can provide in minimizing costs of wind energy conversion, particularly as related to self-regulating controls designed to maximize efficiency under all wind conditions and to protect from dangerous overloading. The research program would consist of a preliminary design of a full scale rotor, stress and loads analysis of this design, fabrication of a dynamically scaled model incorporating the capability to examine various automatic control concepts, and wind tunnel tests of this model to demonstrate the basic feasibility of the Composite Bearingless Rotor as a wind energy rotor as well as to evaluate various control concepts. (auth)

8458 (NSF-RA-N—75-050, pp 256-260) **Structural and dynamic limits upon the size of very large rotors for wind energy conversion systems.** Doman, G.S. (Boeing Vertol Co., West Chester, PA). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

This work is an iterative preliminary structural dynamics design study proposed to U. S. National Science Foundation and U. S. Energy Research and Development Administration. It is intended to: quantify the effects of dynamics design alternatives upon vibratory loads and stresses; find the cost effective physical limits on increased rotor diameter; and define the design features needed to attain greatest reliability and cost effectiveness in very large WECS rotors. (auth)

8459 (NSF-RA-N—75-050, pp 417-425) **Power generation with a vertical-axis wind turbine.** Braasch, R.H. (Sandia Labs., Albuquerque, NM). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The primary goal of the vertical-axis wind turbine program is to demonstrate feasibility of the advantages in a power grid application. In pursuit of such a demonstration additional understanding of the Darrieus vertical-axis wind turbine and experimental verification based upon scaled up hardware are required. The overall goal is to design and construct a machine at the magawatt range power level. Achievement of this goal will be pursued via a three-phase program consisting of a 30kW/sub e/ research system, a 100kW/sub e/ prototype system, and a megawatt range production system. (auth)

8460 (NSF-RA-N—75-050, pp 426-432) **Cost effective diffuser augmentation of wind turbine power generators.** Oman, R.A.; Foreman, K.M. (Grumman Aerospace Corp., Bethpage, NY). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The Diffuser-Augmented Wind Turbine (DAWT) concept to be developed in this project is aimed at increasing the output and reducing the cost, the off-duty time, and the technical risk of large wind turbine systems for commercial power production. Rotors 100 feet in diameter and larger, encased in diffuser shrouds, with the shroud supports functioning as a variable stator stage ahead of the rotor are studied. The stator blades have trailing edge flaps that control turbine inflow angle so that rotors need no pitch or speed change to accommodate to wind speed variations. The goals of the project are to demonstrate large aerodynamic augmentation with very compact diffusers, design and compute the performance of stator/rotor systems that give efficient performance at precisely constant rotational speeds over a broad wind range with fixed-pitch rotors, and to establish cost comparisons for these and competitive wind systems. (auth)

8461 (NSF-RA-N—75-050, pp 433-442) **Vortex augmentor concepts for wind energy conversion.** Sforza, P.M. (Polytechnic Inst. of New York, Farmingdale, NY). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

Suitably designed aerodynamic surfaces are used to generate tornado-like vortical concentration of the natural wind. These surfaces are configured in such a way as to direct the aerodynamic vortices to an appropriately designed rotor system for the purpose of transforming the energy of the wind to shaft work. Such a system constitutes the Vortex Augmentor Concept (VAC). An illustration of the VAC is given. A triangular, or delta, aerodynamic surface at an angle of attack to the wind will generate vortices by leading edge separation of the flow. The contribution of the vortices to the total lift coefficient on such a delta surface is shown. (auth)

8462 (NSF-RA-N—75-050, pp 443-451) **Innovative vertical axis wind machines.** Walters, R.E. (West Virginia Univ., Morgantown, WV). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

Aerodynamic performance and structural requirements will be studied theoretically and experimentally, and initial cost estimates obtained, for two wind machine concepts. The first, a revision of the vertical axis panemone, utilizes high-lift, variable angle-of-attack, circulation-controlled airfoils, and the second, a wind energy concentrator uses a vertical airfoil to form a strong wing tip vortex harnessed by a relatively small, high-speed turbine downstream of the wing tip. 6 references. (auth)

8463 (NSF-RA-N—75-050, pp 452-460) **Giromill (cyclogiro windmill) investigation for generation of electrical power.** Brulle, R.V. (McDonnell Douglas Corp., St. Louis); Larsen, H.C. Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A Giromill is a cyclogiro rotor mounted on a vertical axis. A cyclogiro rotor consists of a set of blades attached to the axis by means of support arms. As the rotor rotates these arms in a circular path, the orientation of the blades is changed, or modulated, to achieve maximum force from the wind. At one point on this circular path, the blades are flipped from a positive to a negative orientation, and vice versa at the diametrically opposite point. The objective of this one-year ERDA-sponsored study program is to theoretically determine the cost effectiveness of the Giromill. A cyclogiro vortex theory computer program has been developed to parametrically analyze Giromill configurations and determine their characteristics. Using this theory, a design and cost analysis of the major system components will be conducted, followed by a design synthesis and selection of promising configurations. The cost effectiveness of the selected Giromill configurations will be compared with that of conventional windmills. (auth)

8464 (NSF-RA-N—75-050, pp 465-467) **Precessor system for wind energy conversion.** Kling, A. Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The Precessor Wind Energy Conversion System is based on a concept which utilizes the rotor system of a wind energy convertor as a gyroscope and uses the precession, which occurs whenever an external torque is exerted on a spinning rotor, to position the rotor to face into the wind and to adjust its position to the slightest changes of wind direction. The system does not fight against the precessional forces of the rotors, but puts precession to work for the system. (auth)

8465 (PB—238595) **Applied aerodynamics of wind power machines.** Wilson, R.E.; Lissaman, P.B.S. (Oregon State Univ., Corvallis (USA)). Jul 1974. 116p. NTIS $5.25.

Aerodynamics of various types of wind power machines and advantages and disadvantages of various schemes for obtaining power from the wind are reviewed. Simple, one-dimensional models for various power producing machines are given along with their performance characteristics and presented as a function of their elementary aerodynamic and kinematic characteristics. Propeller type wind turbine theory is reviewed to level of strip theory including both induced axial and tangential velocities. (GRA)

8466 (SAND—75-0530) **Engineering of wind energy systems.** Banas, J.F.; Sullivan, W.N. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 27p. Dep. NTIS $5.00.

The engineering of wind energy systems is analyzed from the point of view of component selection and performance assessment. Combinations of two load types (variable and constant speed) and three turbine types connected by a fixed-gear-ratio transmission constitute the various systems investigated. The three turbine types result from introducing the notions of nested, unnested, and hybrid power coefficients suggested by current performance characteristics of American Multiblade, Darrieus, and Darrieus/Savonius turbines. The engineering problems associated with these systems are discussed qualitatively, emphasizing the nature, magnitude, and variability of the problems. 11 references. (auth)

8467 (N—75-13384) **Wind power projects of the French Electrical Authority.** Bonnefille, R. Dec 1974. Translation of F—40/74. (NASA-TT-F—16057). 61p. NTIS $4.25.

Systematic measurement of the wind power distribution in France has shown that the design of wind generators involves two basic problems: the irregularity of the energy supply and the mechanical strength of the assembly. Since these problems have largely been solved for generators less than 10 kW, the main body of this discussion deals with practical tests on one average-power and two high-power generators. Other variants tested in France and other countries are described in less detail. Further development of average-power generators with an output on the order of 100 kW is recommended. (auth) (GRA)

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 8428, 8466

8468 (NSF-RA-N—75-050, pp 265-278) **Electrical technology overview and research at Oklahoma State University as applied to wind energy systems.** Ramakumar, R.; Hughes, W.L. (Oklahoma State Univ., Stillwater). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A brief overview is presented of the electrical technology research associated with wind energy conversion systems. Salient features of the research work at Oklahoma State University as applied to wind energy systems sponsored by NSF/RANN Grant GI-39457 are also included. 17 references. (auth)

8469 (NSF-RA-N—75-050, pp 279-289) **Development and adaptation of field modulated generator systems for wind energy applications.** Ramakumar, R. (Oklahoma State Univ., Stillwater). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The plans are summarized for the development and adaptation of field modulated generator systems for wind energy applications to be undertaken at Oklahoma State University under a National Science Foundation Grant No. AER 75-00647. (auth)

8470 (NSF-RA-N—75-050, pp 290-297) **Progress report on employing a non-synchronous ac/dc/ac link in a wind-power application.** Reitan, D.K. (University of Wisconsin, Madison). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

This report is concerned with the experimental electrical work to date regarding building a 20 kW non-synchronous variable frequency input-fixed frequency output AC/DC/AC three-phase to single phase link. (auth)

8471 (NSF-RA-N—75-050, pp 298-306) **Novel electric generation schemes for wind power plants.** Jayadev, T.S. (University of Wisconsin, Milwaukee). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

A variable speed prime mover would drive a conventional a. c. generator with d.c. excitation, resulting in variable frequency. To interconnect the wind energy system (WES) to existing power systems demands the output of WES to be of constant frequency and voltage. Constant voltage can be obtained by common voltage regulator techniques, but obtaining constant frequency from a variable frequency generator is not simple. Converting WES output to "utility grade" power by cost effective techniques is discussed. 10 references. (auth)

8472 (NSF-RA-N—75-050, pp 311-318) **Energy storage for wind energy conversion systems.** Zlotnick, M. (Energy Research and Development Administration, Washington, D.C.). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The technology is discussed for storing energy in a form that will allow it to be recovered economically as electrical energy. One of the goals for energy storage R and D applied to WECS is to make the combined WECS/energy storage system economical as an independent base-load power supply for a wide range of circumstances. One approach that would make such a goal more accessible in the near term would be to recover only a portion of the stored energy - only as much as necessary - in electrical form, with the balance used or stored in a manner. (auth)

8473 (NSF-RA-N—75-050, pp 400-403) **Wind-powered hydrogen/electric systems for farm and rural use.** Biederman, N.P. (Inst. of Gas Tech., Chicago). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The Institute of Gas Technology is conducting a study to minimize cost and expedite the use of wind energy in 5 to 50-kW systems for use in rural and farm settings. Specifically, IGT is evaluating available methods for converting the mechanical, shaft-horsepower from a wind turbine to electricity for direct use and hydrogen as a fuel and storage medium. The electricity can be applied to conventional a-c and d-c applications; used to generate hydrogen for fuel and energy storage; and used to generate hydrogen and oxygen that are stored until recombined electrolytically to generate power when wind currents are inadequate. Such a system is self-sufficient and can be synthesized by coalescing readily available components and systems. The object of IGT's study is to establish an optimum design that can lead to possible demonstration-stage feasibility studies. 6 references. (auth)

SITE CHARACTERISTICS

8474 (NSF-RA-N—75-050, pp 344-352) **Sites for wind-power installations.** Meroney, R.N. (Colorado State Univ., Fort Collins). Sep 1975.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

In Proceedings of the second workshop on wind energy conversion systems.

The objective of this research is to increase technical capacity to locate favorable wind system sites, reduce uncertainty in the prediction or validation of the characteristics of sites, and thus assist in the sizing and performance prediction of wind systems. The research will include evaluation of low speed aerodynamics over terrain and boundary flow conditions over ridges and in valley exits to mountain barriers by means of modeling and analytic techniques. 23 references. (auth)

ELECTRIC POWER ENGINEERING

8475 (CONF-740936—, pp 2-6) **Power engineering research: present status and future trends.** Kasum, K. (Philadelphia Electric Co., PA). 1974.

From Conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In Research in electric transmission and distribution: the university's role.

POWER GENERATION

REFER ALSO TO CITATION(S) 8388, 8817, 8824, 8869

8476 (CONF-740936—, pp 66-82) **EPRI's role in energy research.** Schulte, R.J. (Electric Power Research Inst., Palo Alto, CA). 1974.

From Conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In Research in electric transmission and distribution: the university's role.

The organization, funding, goals, and programs of the Electric Power Research Institute are discussed. EPRI was formed in 1975 and supported by 500 electric utilities in the US for the purpose of sponsoring and promoting research in electric power generation, transmission, distribution and utilization. (LCL)

8477 (CONF-7410146—2) **Operating and maintenance problems of multifuel firing: coal/natural gas/oil.** Mattimore, D. (Wisconsin Dept. of Administration, Madison (USA). Bureau of Facilities Management). 1974. 8p.

From Industrial fuel conference; West Lafayette, Indiana, United States of America "USA" (2 Oct 1974).

In order to take advantage of fuel procurement difficulties and price advantages, it is beneficial if a plant can operate on two or more fuels. Normally, a plant would burn the most economical fuel; however, circumstances might dictate use of a backup or standby fuel. Interruptable natural gas is the least costly fuel; however, it is fast becoming unavailable during the heating season. Frequently, this curtailment occurs on a few hours notice and the ability to switch to alternate fuels, or reduce natural gas consumption by simultaneous firing, can avoid loss of load during a fuel change. It is recommended that the benefits which can be derived from simultaneous firing of two fuels outweigh the few problems which they might present. The advantages are: (1) fuel market conditions can be taken advantage of; (2) boilers are more versatile and plant additions can be averted; (3) greater combustion safety can be achieved as fire is always present in the furnace; (4) improved combustion efficiency can be attained; (5) gas streams can be cleaned of particulates and diluted; and (6) combination firing permits burning of marginal fuels. (RCK)

8478 (CONF-750867—) **Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.** Fink, L.H.; Carlsen, K. (eds.). (Energy Research and Development Administration, Washington, D.C. (USA)). 1975. 487p. Dep. NTIS $10.60.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

Twenty-two papers were presented at the conference. A separate abstract was prepared for each paper for ERA. In addition, one paper was also abstracted for NSA. (RCK)

8479 (PB—239408) **Study of an integrated power, water, and wastewater utility complex. Final report.** (SEE CODE- 4643000 New York State Atomic and Space Development Authority, New York (USA)). Dec 1974. 238p. NTIS $7.50.

This report evaluates, technically and economically, a new approach to siting power generation, wastewater treatment and water supply facilities. It is concluded that the integrated facility results in more efficient utilization of land and water resources, produces a net reduction in undesirable process effluents, and achieves at a reduced cost many of the environmental quality goals sought today. In particular, the use of waste heat for the beneficiation of wastewater treatment was determined to be sufficiently promising to merit further investigatory research. (GRA)

8480 (ERDA-tr—104) **Instructions on inventorying coal and shale at electric power stations.** Filanovskii, Z.G.; Osolovskii, V.P.; Aleksandrov, A.N. 1970. Translation of Instruktsiya po inventarizatsii uglya i slantsa na elektrostantsiyakh, Moscow, 1970. 41p. Dep. NTIS $4.00.

Instructions are presented for weighing, sampling, measuring, and certifying the amount of coal on hand at power plants in the USSR. Plant personnel responsibilities in carrying out these inventory instructions are specified. (LCL)

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 8597

8481 (COO—2673-1) **Demonstration of adiabatic cooling to improve the performance of air-cooled heat exchangers.** Rubin, A.M. (Franklin Inst., Philadelphia, Pa. (USA)). Oct 1975. 37p. Dep. NTIS $4.00.

A demonstration of improved heat exchanger performance by adiabatically cooling the inlet air to an air-cooled heat exchanger was performed on a condenser that had a design heat rejection rate of 58 million Btu/hr. Pneumatic nozzles were used to inject atomized water into the inlet air stream. Mean droplet diameters ranged from 16 to 28 microns for all of the tests. Results of these experiments comparing conventional and adiabatic cooling showed that adiabatic cooling does improve heat transfer performance in accordance with expectations. The operation of the system was simple and reliable. Visual observations of the heat exchanger showed that finned surfaces remained dry even when enough water was added to saturate the inlet air. With the use of efficient atomizers, adiabatic cooling improves efficiency at a steam-electric power plant without increasing dry cooling tower size, and thereby avoids the need to reduce plant output during hot weather.

8482 (LA-UR—75-2313) **Amorphous silica scale in cooling waters.** Midkiff, W.S.; Foyt, H.P. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-eng-36. 19p. (CONF-760109—1). Dep. NTIS $3.50.

From The Cooling Tower Institute annual meeting; Houston, Texas, United States of America "USA" (Jan 1976).

In 1968, most of the evaporation cooled recirculating water systems at Los Alamos Scientific Laboratory were nearly inoperable due to scale. These systems, consisting of cooling towers, evaporative water coolers, evaporative condensers, and air washers had been operated on continuous blowdown without chemical treatment. The feedwater contained 80 mg/l silica. A successful program of routine chemical addition in the make-up water was begun. Blends of chelants, dispersants and corrosion inhibitors were found to gradually remove old scale, prevent new scale, and keep corrosion to less than an indicated rate of one mil per year. An explanation has been proposed that amorphous silica by itself does not form a troublesome scale. When combined with a crystal matrix such as calcite, the resultant silica containing scale can be quite troublesome. Rapid buildup of silica containing scale can be controlled and prevented by preventing formation of crystals from other constituents in the water such as hardness or iron. (auth)

COMBINED AND BINARY CYCLES

REFER ALSO TO CITATION(S) 8182

8483 (SAND—75-6167) **Flux compression topping stage.** Leisher, W.B.; Cowan, M.; Tucker, W.K. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 13p. (CONF-760215—1). Dep. NTIS $3.50.

From 16. annual ASME symposium on energy alternatives; Albuquerque, New Mexico, United States of America "USA" (26 Feb 1976).

A topping stage concept is described which is to be used with conventional coal or oil-fired generating stations. It is based on a linear reciprocating flux-compression generator, called PULSAR. All, or part, of fuel combustion may take place in the PULSAR unit. The thermodynamic cycle is similar to that of a free-piston diesel engine except that combustion takes place initially at constant volume, then at constant temperature during expansion. The hot (1200 to 2000°K) exhaust gasses then serve as a heat source for steam production. The electrical portion of PULSAR consists of a superconducting magnet, generator coil, piston-like armature, and pulse-to-60 Hz conditioning equipment. Armature velocity is maintained sufficiently high (135 m/s) to assure that flux compression occurs. Calculations and experimental data show that a load electrical energy of approximately two times the superconducting magnetic energy can be obtained for each cycle through extracting about half of the kinetic energy from the armature. Remaining kinetic energy is used to compress incoming air for the next cycle. Preliminary calculations show that for a conventional plant overall thermal efficiency of 35%, addition of the PULSAR stage can easily increase overall thermal efficiency to 46% at a net output of 800 MW with higher efficiency possible. PULSAR output is 440 MW while the conventional plant provides the remaining 360 MW. PULSAR is also applicable to smaller plants and could be built as a strap-on unit for existing plants. Problem areas, future work, and experimental results are also discussed.

SOLID-WASTE INCINERATION

REFER ALSO TO CITATION(S) 8365

POWER PLANT COMPONENTS

REFER ALSO TO CITATION(S) 8719

8484 (ERDA-tr—103) **Technical safety rules for servicing fuel transport equipment at electric power stations. Chapter 2. General rules of safety.** [nd]. Translated from the Russian. 10p. Dep. NTIS $3.50.

USSR safety regulations for facilities used to store and transport fossil fuels at electric power generating plants are presented. (LCL)

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 8363

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8476, 8806, 8815, 8816, 8859

NOXIOUS GAS CONTROL

REFER ALSO TO CITATION(S) 8231, 8232, 8864

SITE SELECTION

REFER ALSO TO CITATION(S) 8865, 8866, 8867, 8868

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 8476, 8870

8485 (CONF-740936—, pp 122-150) **Distance protection of power transmission lines by digital impedance techniques.** Manes, E.E. Jr.; Ott, G.E.; Walker, L.N. 1974.

From Conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In Research in electric transmission and distribution: the university's role.

This paper proposed a method of distance type protection for transmission lines that provide fast primary protection as well as a very accurate indication of fault location. Accuracy is obtained in the method by integrating fault waveforms over one cycle of the base frequency to define the dc transient and then post-processing the fault data to eliminate the transients. The results of simulations run on an IBM-360, to determine how effectively the transients can be eliminated, are described.

8486 (KFK—2207) **Comparison of advanced high power underground cable designs.** Erb, J.; Heinz, W.; Hofmann, A.; Koefler, H.J.; Komarek, P.; Maurer, W.; Nahar, A.; Heller, I. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Sep 1975. 171p. Dep. NTIS (US Sales Only) $6.75.

Advanced high power underground cable designs are compared in the light of the available literature, of reports and information supplied by participating industries (AEG, BICC, CGE, Pirelli, Siemens), spontaneous contributions by EdF, France, BBC and Felten and Guilleaume Kabelwerke A. G., Germany, and Hitachi, Furukawa, Fujikura and Sumitomo, Japan, and earlier studies carried out at German public research centers. The study covers cables with forced cooling by oil or water, SF_6-cables, polyethylene cables, cyroresistive and superconducting cables. (auth)

AC SYSTEMS, EHV AND UHV

8487 (CONF-740936—, pp 32-50) **Development of a compressed-gas-insulated transmission line.** Pedersen, B.O.; Doepken, H.C. Jr.; Bolin, P.C. (High Voltage Power Corp., Westboro, MA). 1974.

From Conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In Research in electric transmission and distribution: the university's role.

Development of Compressed-Gas-Insulated transmission lines for voltages of 138 to 500 kV is described. Design, manufac-

ture and installation are presented. Dielectric and mechanical tests data are given. A 230 kV single-phase outdoor test line of 230-ft length has been installed and voltage and current tests have been initiated. Thermal data for currents up to 3000 A are reported.

8488 (EPRI—7825-FR) **Optimized design for gas cable systems. Final report.** Cronin, J.C. (I-T-E- Imperial Corp., Greensburg, Pa. (USA)). Sep 1975. Contract E(49-18)-1615. 226p. Dep. NTIS $8.00.

For Electric Power Research Inst., Palo Alto, CA.

The results of an 18-month research study on the optimization of gas-filled cables for high voltage underground power transmission are presented. Information is included on computer programs for evaluating single- and three-conductor designs and for comparing aboveground and underground installation modes; systems capability; economics and demand; cost of SF_6 transmission line; development of metallic and nonmetallic enclosures and of conductor joints; insulation performance; and field testing. (LCL)

8489 (EPRI—7825-TR) **Guide to the use of gas cable systems. Technical report.** Cronin, J.C. (I-T-E- Imperial Corp., Greensburg, Pa. (USA)). Sep 1975. Contract E(49-18)-1615. 126p. Dep. NTIS $5.50.

For Electric Power Research Inst., Palo Alto, CA.

A state-of-the-art report presents data which allow a technical and economical evaluation of gas-insulated transmission lines. Their features and typical areas of application are described. This guide provides the utility systems designer with the basis for selecting and specifying gas-insulated transmission systems. Refer to the colored pages for quick reference about economic application in terms of voltage, power level, and transmission distance. Also ampacities are tabulated with correction factors for a wide range of installation parameters. Prices of standard designs are given for estimating purposes. The design criteria related to thermal, dielectric, and economic factors are summarized. A computer program for optimized design of gas-insulated transmission lines has been developed into a practical tool, available upon request from EPRI. The procedures for installation, testing, operation, and repair are described in detail. The results of advanced research and development are described in the Final Report of the project "Optimization of and Guide to the Design and Use of Gas Cable Systems". (auth)

8490 (SAND—75-0667) **Surface flashover measurements on conical insulators suggesting possible design improvements.** Anderson, R.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 24p. Dep. NTIS $4.50.

Plexiglas insulators in the form of truncated cones are subjected in vacuum to high-voltage pulses having 3 ns risetime. The breakdown voltage is found to depend more strongly on cone angle at angles near 0^0 than has been reported for pulses having longer risetime. The time delay between voltage application and breakdown is measured, with nanosecond resolution, as a function of breakdown voltage and cone angle, ad the effects of electrode needles and altered insulator shape near the cathode end are determined. These measurements indicate that surface flashover can proceed by two distinct mechanisms, each sensitive to details at the appropriate insulator-electrode junction. Flashover initiated at the insulator-cathode junction involves a secondary electron emission avalanche. A time delay varying as the inverse square of electric field is required for a low-impedance discharge to develop. On the other hand, the anode-initiated flashover mechanism apparently propagates across the insulator surface at a velocity proportional to the third or fourth power of electric field. A small sample is found to break down at nearly the same electric field as a large-scale insulator when deliberate imperfections are introduced at the insulator-electrode junctions. These results suggest the performance of large-scale insulators may be improved significantly by improving the junctions. Alternative designs are proposed, including two which eliminate and make use of, respectively, leakage currents emitted from the cathode junction. Additional factors affecting breakdown are considered, including insulator surface condition, magnetic fields, and ultraviolet light. Performance under fast-pulsed conditions may be improved by semiconducting coatings or by magnetic fields having flux density greater than 0.4 T. (auth)

8491 **Ability of power systems to survive during major disturbances: effect of power plant response.** Schulz, R.P. (General Electric Co., Schenectady, NY); Ewart, D.N.; Gulachenski, E.M. *Proc. Am. Power Conf.*; 37: 930-941(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

This paper discusses the effect of power plant response on the ability of power systems to ride through major power system disturbances with a minimum loss of service to customers. The paper begins with a review of several actual power system incidents in which it was found that power plant dynamic performance had a significant adverse influence. Next, a computer simulation program called LOTDYS is described which enables simulations of such incidents for periods of several minutes to be obtained. The paper concludes with results of simulations which show how changes in power plant characteristics had a beneficial effect on simulated disturbances.

DC SYSTEMS

8492 (CONF-740936—, pp 151-163) **High-voltage dc interruption.** Gilmour, A.S. Jr. (State Univ. of New York, Buffalo). 1974.

From Conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In Research in electric transmission and distribution: the university's role.

Three techniques for accomplishing the interruption of high-voltage dc circuits are described. The first, which has been demonstrated by the General Electric Company, is similar in many respects to that proposed by several organizations. A commutation capacitor is used to force a current zero in a circuit breaker. Current and voltage profile shaping circuit elements are used to insure that the time rates of change of current and voltage do not exceed the breaker capabilities. The second, interruption technique, being developed by the Hughes Company utilizes a gas-filled switch tube that conducts in a Penning discharge mode when a magnetic field is applied to it. The third technique, developed at the State University of New York at Buffalo for high power modulator and inverter applications, utilizes a switch tube in which a vacuum arc is extinguished by the application of a pulsed magnetic field. The operating levels of each of the interruption techniques and devices is described along with advantages and disadvantages of each.

8493 **Energy transport system and method.** Skala, S.F. US Patent 3,911,288. 7 Oct 1975. Filed date 21 Jan 1974. 6p.

A liquid metal, such as sodium potassium eutectic NaK, is a recycleable fuel which is transported from a generating facility to distributing stations through underground pipelines. The liquid metal within the pipeline transmits electrical power. An adjacent pipeline returns reaction products of the liquid metal in solution to the generating facility for reconversion to liquid metal.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

REFER ALSO TO CITATION(S) 9213, 9216

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 8116, 8835, 8836, 8869, 9100

8494 (CONF-740341—P2) **1974 electric utility engineering conference, Pittsburgh, Pennsylvania, March 3—15, 1974. Volume II. Nuclear power.** (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 1974. 221p. Westinghouse Electric Corp., Pittsburgh, PA $5.00.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

Separate abstracts were prepared for 12 of the 13 papers included. An abstract for one paper has previously appeared in NSA. (JWR)

8495 (CONF-750515—, pp 2-18) **Training of nuclear facility personnel: boon or boondoggle.** Remick, F.J. (Pennsylvania State Univ., University Park). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

The training of nuclear facility personnel has been a requirement of the reactor licensing process for over two decades. However, the training of nuclear facility personnel remains a combination of boon and boondoggle. The opportunity to develop elite, well trained, professionally aggressive reactor operation staffs is not being realized to its full potential. Improvements in the selection of personnel, training programs, operational tools and professional pride can result in improved plant operation and contribute to improved plant capacity factors. Industry, regulatory

agencies, professional societies and universities can do much to improve standards and quality of the training of nuclear facility personnel and to improve the professional level of plant operation. (auth)

8496 (CONF-750515—, pp 19-32) **Training requirements for nuclear power plant personnel.** Buzy, J.J. (U.S. Nuclear Regulatory Commission, Washington, DC). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

The Code of Federal Regulations requires that Safety Analysis Reports for Nuclear Power Plants contain the training programs for facility personnel. The training programs are required at the PSAR and FSAR review period. Training program requirements are outlined in the NRC Regulatory Guides and in Industry Standards. NRC review policy and acceptance criteria are contained in Regulatory Standard Review Plans. Current NRC is described. Trained and qualified personnel are required at various phases of plant construction and operation, therefore, training programs must be developed and initiated with these objectives. Training programs for replacement personnel, requalification programs for licensed operators, and refresher training for other staff members are required for the full term of the facility operating license. (auth)

8497 (CONF-750515—, pp 33-52) **Inspection of training activities by the NRC's Office of Inspection and Enforcement.** Ruhlman, W.A. (U.S. Nuclear Regulatory Commission, Washington, DC). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

New requirements in the Code of Federal Regulations, the issuance of new Regulatory Guides and ANSI Standards, have indicated the increased emphasis being placed on training by forces in the Nuclear Industry and the Nuclear Regulatory Commission. A brief description is presented of the functions of the Office of Inspection and Enforcement in the training areas. Three areas are examined: general inspection techniques; training inspection scope; and training inspection bases. (auth)

8498 (CONF-750515—, pp 53-70) **U.S. Nuclear Regulatory Commission operator and senior operator license 1971—1974 examination results.** Collins, P.F. (U.S. Nuclear Regulatory Commission, Washington, DC). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

Examination results are presented for the years 1971—1974. The results are presented by type of license applied for and type of examination administered. The average category grades are given for operator applicants and senior operator applicants. (auth)

8499 (CONF-750515—, pp 71-84) **Why operators fail licensing examinations.** Roth, D.R.; Zerbo, J.N. (General Physics Corp., Columbia, MD). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

A survey was conducted among nuclear utility operators who have taken NRC licensing examinations to determine which factors they considered important in their success or failure. The operators also compared the actual NRC examination with their expectations prior to taking the examination. The results of the survey supplement NRC statistics with regard to failure rates. Over 350 operators and 20 utilities participated in the survey and a good cross section of the nuclear community is represented. Reactor theory and emergency procedures are important areas in which operators found NRC emphasis to be different than expected. Observation Training and Design Lecture Series are two training segments which appear to require improvement. Recommendations are made for the use of data collected through this survey and for continuation of the effort to give operators a mechanism of supplying feedback to the training and licensing process. (auth)

8500 (CONF-750515—, pp 85-92) **ERDA outlook on training of nuclear fuel cycle personnel.** McCool, W.J. (Energy Research and Development Administration, Washington, DC). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

The basis for training and certification of nuclear facility personnel is discussed pursuant to the authority set forth in the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, ERDA Manual Chapter issuances and procurement regulations. The current status of ERDA's training requirements is described with respect to responsibility, implementation, uniformity, and quality of programs. An overview of the future direction of ERDA's role in promulgating training program standards and objectives is presented. The concern of society, the matter of equivalence, the needs of the operating nuclear facilities and the thrust of the Energy Reorganization Act of 1974 are cited as bases for proposed expansion of the health and safety and environmental overview of ERDA programs. (auth)

8501 (CONF-750515—, pp 171-185) **Planning to meet future manpower requirements.** Deutsch, R.W. (General Physics Corp., Columbia, MD). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

Most organizations in the nuclear industry will have to hire inexperienced personnel who may also lack academic qualifications in order to satisfy their future manpower requirements. It will be necessary to utilize appropriate in-house training programs to prepare personnel for particular job responsibilities as well as meet quality assurance requirements that satisfy NRC and ANSI standards. In particular, these programs will have to be directed at providing future sources of engineers, operators, and technicians. Specific programs for engineers, commercial plant operators, and technicians and maintenance personnel are described. It is the responsibility of management of major organizations in the industry to initiate and implement training programs that will provide the necessary numbers of trained personnel. (auth)

8502 (CONF-750515—, pp 187-193) **Station staff: sources, selection, and training of qualified candidates.** Thomas, E.L. (Duke Power Co., Charlotte, NC). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

Increased experience with large commercial nuclear power generating facilities has provided additional insight into the areas of personnel acquisition and training. The current sources of trainable manpower are discussed and the characteristics and training requirements of each group are described. Applicant screening and the associated requirements of the Civil Rights Act, Fair Credit Reporting Act, Family Education and Privacy Act, and the Security Regulations of the Atomic Energy Commission are also discussed. (auth)

8503 (CONF-750515—, pp 235-251) **Training nuclear technicians in two-year, post-secondary educational programs.** Hull, D.M.; Roney, M.W. May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

An available and economical supply to future manpower requirements for various types of nuclear technicians can be met by developing and/or restructuring two-year, post-secondary programs at local educational institutions. The Technical Education Research Centers program is under contract from the U.S. Office of Education to delineate the job requirements and develop curricula and instructional materials for two-year, post-secondary training of nuclear technicians. Six job categories have been identified along with corresponding tasks which the technician performs. These categories are: Reactor Operator, Nuclear Instrumentation Technician, Nuclear QA/QC Technician, Radiochemistry Technician, Radiation Protection Technician and Nuclear Medicine Technician. For the first five categories curricula have been established, courses have been described, and instructional materials are being written. (auth)

8504 (CONF-750515—, pp 253-260) **Training program for nuclear utilities.** Jones, D.W. (Memphis State Univ.). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

Several questions must be addressed by a university which plans applied training for nuclear utilities. Among those problems are: (1) what type of training is needed by nuclear utilities, (2) what mode of delivery should be used, and (3) how should the training be structured within the university. The Memphis State University answers to these problems are presented and the potential effect upon the university curriculum is discussed. (auth)

8505 (CONF-750515—, pp 277-291) **Role of universities in training nuclear facility personnel.** Hornyik, K.; Wang, C.H. (Oregon State Univ., Corvallis). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

The universities have a long tradition, a vast pool of experience, and the proper facilities to make significant contributions to the supply of qualified manpower to nuclear industry. Their capabilities will have to be relied upon and indeed will have to be expanded if nuclear power is to provide a major share of energy demand for the next several decades. It is the responsibility of universities to devise long-range plans to train people for various tasks associated with nuclear power development including research, design, construction, and management. Lack of communication and conflicting interests between pure research and applied project orientation of their efforts are seen as the main obstacles. These problems are given a close scrutiny and solutions are suggested, some of which already have been implemented successfully at Oregon State University and some other institutions. (auth)

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 8688, 8690, 8694, 8699, 8706, 8711, 8712, 8713

8506 (GA-A—13813) **Dresden 1 Plutonium Recycle Program report, January 1, 1974—June 30, 1975.** Wan, M.Y. (General Atomic Co., San Diego, Calif. (USA)). Dec 1975. Contract AT(11-1)-2210. 21p. Dep. NTIS $3.50.

Included are a summary of reactor operations, power and exposure histories for each mixed-oxide assembly, and the plans and schedule for the remainder of the program.

8507 (NEDO—11209—02) **Nuclear Energy Divisions Boiling Water Reactor Quality Assurance Program description.** (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Dec 1975. 67p. General Electric Co., San Jose, CA.

The QA Program which is applied generally throughout the GE Nuclear Energy Divisions, but which is specifically applicable to the safety-related functional aspects of systems and components within the domestic BWR scope of supply. This scope of supply includes nuclear steam supply systems, nuclear fuel, and the standard reactor island design (STRIDE). The QA Program is designed to provide assurance that the quality-related work elements for systems, components (including spares and replacement parts) and services included in the BWR scope of supply, are identified and controlled. Specific responsibilities of personnel and organizations are assigned and documented for quality-related activities throughout the major steps of design and construction of the nuclear power plant projects, encompassing the broad phases of: (1) Contract definition; (2) preliminary design; (3) systems and components design and specification; (4) supplier evaluation and selection; (5) material and component procurement; (6) fabrication and assembly of components and systems; (7) inspection and testing; (8) cleaning, packing, and shipping; (9) installation and erection; and (10) preoperational and startup testing. (auth)

8508 (NEDO—21069) **Mark III containment seismic slosh.** Reuter, F.; Petite, D.L. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Dec 1975. vp. General Electric Co., San Jose, CA.

Analytical and experimental investigations were conducted to evaluate the influence of seismic induced slosh waves on the Mark III containment when subjected to earthquake loading. Most of the work was performed on a $^1/_{30}$ scale physical model of the 238 Standard Plant which was designed to provide information on basic liquid slosh responses. A $^1/_{15}$ scale model of the 238 Standard Plant was also tested to verify the analytical predictions for suppression pool and to determine natural frequencies. A detailed description is presented of the results obtained from the experiments on the scaled models and also on a corresponding analytical model. Fundamental studies are included which establish the appropriate scaling laws, and verify their applicability for sinusoidal type excitation. (auth)

8509 (PGE—8003(Rev.0)) **Nuclear projects quality assurance program for design, construction, and preoperational testing.** (Portland General Electric Co., Oreg. (USA)). Dec 1975. 94p.

The program for the control of quality-related activities of Portland General Electric during the design, construction, and preoperational testing of the Trojan and Pebble Springs Nuclear Stations is described. (JWR)

8510 **Fuel assembly for a boiling water reactor.** Andersson, I.; Santen, A.V. (to Asea-Atom). US Patent 3,915,793. 28 Oct 1975. Priority date 22 Jun 1972, Sweden. 2p.

A boiling water reactor fuel assembly is described which has vertical fuel rods and guide tubes positioned below the fuel rods and receiving control rod fingers and acting as water pipes, the guide tubes each being formed of a plurality of parts including a part secured to a grid plate positioned in the fuel assembly container, and low parts which fit into holes formed in the bottom of the fuel assembly. There is a flexible connection between the upper and lower parts of the guide tubes to allow for a certain tolerance in the procedure of manufacturing the various parts to allow insertion of the fuel rod bundle into the fuel assembly container. (Official Gazette)

8511 **Development of underwater plasma arc cutting.** Wodtke, C.H.; Plunkett, W.A.; Frizzell, D.R. (Oak Ridge National Lab., TN). *Weld. J. (N.Y.)*; **55**: No. 1, 15-24(Jan 1976).

Procedures for underwater plasma arc cutting and piercing and unique operating cycles were developed to cut the 1-in. stainless steel plate of the inner thermal shield of the ERR. A plasma torch manipulator and a cutting control panel were designed and built for remote automated underwater plasma arc cutting of the inner thermal shield and for subsequent in-air cutting of other components. Commercial plasma arc cutting equipment was usable with only minor modification to torches and high frequency generator. The cutting equipment and operating procedures were demonstrated to be workable and practical by cutting and piercing fairly large test plates in a full size mockup of the ERR vessel. At the ERR, underwater plasma arc cutting and removal of the inner thermal shield were accomplished in five weeks under difficult remote working conditions. The plasma arc cutting torches and associated equipment performed satisfactorily. Certain minor changes in cutting parameters were made necessary by job circumstances. The control panel and the plasma torch manipulator proved suitable for underwater plasma arc cutting of the inner thermal shield, and also for in-air plasma arc cutting of the reactor vessel and for torch manipulation during oxyacetylene cutting of the outer thermal shield. 13 figs (auth)

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 8684, 8686, 8688, 8690, 8691, 8692, 8694, 8699, 8706, 8711, 8714

8512 (BAW—10102(Rev.2)) **ECCS evaluation of B and W's 205-FA NSS.** Lowe, R.J.; Anderson, G.E. Jr.; Dunn, B.M. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Dec 1975. vp. Babcock and Wilcox, Lynchburgh, VA.

The effectiveness of the ECCS for B and W's 205-fuel assembly plants is evaluated and shown to meet all the requirements of 10 CFR 50.46. The results of various sensitivity studies, a spectrum of breaks, and an analysis to determine allowable linear heat rates under 10 CFR 50.46 are presented. 14 references (auth)

8513 (BAW—10104(Rev.1)) **B and W's ECCS evaluation model.** Dunn, B.M.; Jones, R.C.; Cartin, L.R.; Parks, C.E.; Salm, R.J. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Dec 1975. vp. Babcock and Wilcox, Lynchburgh, VA.

The generic model for evaluating the performance of emergency core cooling systems following a loss-of-coolant accident for all B and W NSSs is developed and compared with the required and acceptable features contained in Appendix K of the Code of Federal Regulations, 10 CFR 50. Both the large- and small-break evaluation models are presented and are shown to conform to Appendix K. (auth)

8514 (CONF-740341—P2, pp vp Paper 10) **Nuclear power overview.** Retallick, F.D. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

Westinghouse PWR steam supply system designs are reviewed. Experience with standardization of nuclear plant design is discussed. The Westinghouse reactor design and fabrication facilities are briefly described. (JWR)

8515 (CONF-740341—P2, pp vp Paper 11) **Westinghouse nuclear power plant operating experience.** Boettinger, W.L. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

Some significant milestones for Westinghouse PWR plants operating in 1973 are reviewed. Several tables are presented on power generation, plant availability, outages, and other operations data. (JWR)

8516 (CONF-740341—P2, pp vp Paper 12) **Nuclear fuel cycle.** Bauhs, D.J. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

The unique nature of nuclear fuel which makes it subject to unlimited management variations is discussed. An approach to determining nuclear fuel costs, based on the use of investment-time diagrams, is presented. An illustrative analysis using a Westinghouse 3800 MW(t) PWR is presented. (JWR)

8517 (CONF-740341—P2, pp vp Paper 13) **Westinghouse nuclear fuel operating experience.** Roll, J.B. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

Operating experience with Westinghouse Zircaloy-clad nuclear fuel is reviewed. Problems related to moisture, fuel densification, rod flattening, fretting, and rod bowing are discussed. (JWR)

8518 (CONF-740341—P2, pp vp Paper 15) **Westinghouse PWR development.** Von Hollen, H.J. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

The Westinghouse 3817 MW(t) nuclear steam supply system is described. The goals set for the design of this reactor system are discussed. The rapid refueling feature of this reactor is described. (JWR)

8519 (CONF-740341—P2, pp vp Paper 16) **Floating nuclear plant.** Nichols, R.C. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

The development of offshore nuclear power plants is reviewed. Topics discussed include plant and site design features, steam supply system design, manufacturing concept, and siting and environmental considerations. (JWR)

8520 (CONF-740341—P2, pp vp Paper 18) **Nuclear plant service requirements.** Mendez, W.E. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

Westinghouse development and application of systems for detection of abnormal primary circuit conditions the use of vibration and acoustic techniques is described. The objective has been to develop systems that will result in early detection of malfunctions. (JWR)

8521 (CONF-740341—P2, pp vp Paper 19) **PWR quality assurance.** Burgess, J.A. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

PWR quality assurance is discussed under the following headings: organization; quality assurance programs; design control; procurement control; corrective action; and audits. (JWR)

8522 (CONF-750515—, pp 225-233) **Indian Point training staff.** Burdge, R.E. (Consolidated Edison Co. of New York, Inc.). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

A description is given of the Indian Point training staff, including comments on the qualifications and duties of each member of the staff. (DG)

8523 **Training simulator for nuclear power plant reactor control model and method.** Czerbuejewski, F.R. (to Westinghouse Electric Corp.). US Patent 3,914,794. 21 Oct 1975. Filed date 23 Feb 1973. 16p.

A description is given of a method and system for the real-time dynamic simulation of a nuclear power plant for training purposes, wherein a control console has a plurality of manual and automatic remote control devices for operating simulated control rods and has indicating devices for monitoring the physical operation of a simulated reactor. Digital computer means are connected to the control console to calculate data values for operating the monitoring devices in accordance with the control devices. The simulation of the reactor control rod mechanism is disclosed whereby the digital computer means operates the rod position monitoring devices in a real-time that is a fraction of the computer time steps and simulates the quick response of a control rod remote control lever together with the delayed response upon a change of direction.

8524 **Fluid distribution network and steam generators and method for nuclear power plant training simulator.** Alliston, W.H.; Johnson, S.J.; Mutafelija, B.A. (to Westinghouse Electric Corp.). US Patent 3,914,795. 21 Oct 1975. Filed date 23 Feb 1973. 30p.

A description is given of a training simulator for the real-time dynamic operation of a nuclear power plant which utilizes apparatus that includes control consoles having manual and automatic devices corresponding to simulated plant components and indicating devices for monitoring physical values in the simulated plant. A digital computer configuration is connected to the control consoles to calculate the dynamic real-time simulated operation of the plant in accordance with the simulated plant components to provide output data including data for operating the control console indicating devices. In the method and system for simulating a fluid distribution network of the power plant, such as that which includes, for example, a main steam system which distributes steam from steam generators to high pressure turbine steam reheaters, steam dump valves, and feedwater heaters, the simultaneous solution of linearized non-linear algebraic equations is used to calculate all the flows throughout the simulated system. A plurality of parallel connected steam generators that supply steam to the system are simulated individually, and include the simulation of shrink-swell characteristics. (Official Gazette)

8525 **Training simulator for nuclear power plant reactor coolant system and method.** Alliston, W.H.; Desalu, A.A. (to Westinghouse Electric Corp.). US Patent 3,916,445. 28 Oct 1975. Filed date 23 Feb 1973. 46p.

A description is given of a method and system for simulating the dynamic real-time operation of a nuclear power plant wherein a plurality of remote control devices provides input data to a digital computer to calculate physical values corresponding to plant operation to operate indicating devices for monitoring the physical operation of the plant. The simulation includes the dynamic operation of the reactor coolant loops for normal, reverse, and natural coolant flow and corresponding heat transfer; also the simulation of the pressurizer in its solid, bubble, and transitional states together with its interaction with the reactor coolant loops. (Official Gazette)

8526 **Steam generator for a pressurized-water coolant nuclear reactor.** Schroeder, H.J. (to Siemens Aktiengesellschaft). US Patent 3,915,122. 28 Oct 1975. Priority date 19 Dec 1972, German, Federal Republic of (F.R. Germany). 6p.

A description is given of a steam generator for a pressurized-water coolant nuclear reactor which is of the type having a vertical housing with its lower portion closed by a horizontal tube sheet in which the inlet and outlet legs of an inverted U-shaped tube bundle are mounted, one forming an inlet leg and the other forming an outlet leg for the pressurized-water coolant circulated via the tube bundle and the reactor. The tube bundle is peripherally enclosed by a vertical shell forming a feed-water descent space between it and the housing with this space adjacently above the tube sheet peripherally opening to the latter for radially inwardly directed feed-water flow thereover through the interspaced tubes of the tube bundle legs and upward flow through the latter to generate steam in the housing. (Official Gazette)

8527 **Training simulator for nuclear power plant reactor monitoring.** Alliston, W.H.; Czerniejewski, F.R.; Mutafelija, B.A. (to Westinghouse Electric Corp.). US Patent 3,916,444. 28 Oct 1975. Filed date 23 Feb 1973. 40p.

A description is given of a method and apparatus for the real-time dynamic simulation of a nuclear power plant that includes a control and nuclear instrumentation console for operating the reactor and monitoring three-dimensional physical values in the reactor core. A digital computer is connected to the console to calculate physical values such as nuclear flux, power, and temperature including the distribution thereof throughout the core with such calculations including the effect of full length, part length, and malfunctioned reactor control rods, as well as xenon, decay heat and boron, for example, on the output and distribution of power within the core. The simulation also includes instrumentation that responds to the calculated physical values by recording a continuous trace of the flux value in the reactor core from the top to the bottom. (Official Gazette)

8528 Steam generator for a pressurized-water coolant nuclear reactor. Schroeder, H.J.; Berger, W. (to Siemens Aktiengesellschaft). US Patent 3,916,841. 4 Nov 1975. Priority date 22 Dec 1972, German, Federal Republic of (F.R. Germany). 6p.

A description is given of a steam generator which has a vertical cylindrical housing having a steam output outlet, a horizontal tube sheet closing the lower end of this housing, and an inverted U-shaped tube bundle inside of the housing and having vertical inlet and outlet legs with their ends mounted in the tube sheet. Beneath the tube sheet there are inlet and outlet manifolds for the respective ends of the tube bundle so that pressurized-water coolant from a pressurized-water coolant nuclear reactor can be circulated through the tube bundle. (Official Gazette)

8529 Reactor vessel supported by flexure member. Crawford, J.D.; Pankow, B. (to Combustion Engineering, Inc.). US Patent 3,916,944. 4 Nov 1975. Filed date 28 Jun 1973. 6p.

A description is given of a reactor pressure vessel which is provided with vertical support means in the form of circumferentially spaced columns upon which the vessel is mounted. The columns are adapted to undergo flexure in order to accommodate the thermally induced displacements experienced by the vessel during operational transients. (Official Gazette)

8530 Nuclear power plant training simulator modeling organization and method. Alliston, W.H. (to Westinghouse Electric Corp.). US Patent 3,919,720. 11 Nov 1975. Filed date 23 Feb 1973. 40p.

A description is given of a training simulator for the full-scope real-time dynamic operation of a nuclear power plant which utilizes apparatus that includes control consoles having manual and automatic devices corresponding to simulated plant components and indicating devices for monitoring physical values in the simulated plants. A digital computer configuration is connected to the control consoles to calculate the dynamic real-time simulated operation of the plant in accordance with the simulated plant components to provide output data including data for operating the control console indicating devices. The plant simulation is modularized into various plant components or component systems. Simulated plant components or component systems are described by a mathematical equation embodied in a computer program which accepts data from other simulated plant components or systems, calculates output values including values which are used as inputs for simulator calculators by other simulated plant components or systems, and responds in a manner similar to that of its corresponding physical entity in both transient and steady states. (Official Gazette)

8531 Emergency core cooling spray head. Calvin, J.N. (to Combustion Engineering, Inc.). US Patent 3,920,514. 18 Nov 1975. Filed date 18 Oct 1973. 6p.

A description is given of an apparatus for supplying emergency coolant fluid to the core region of a nuclear reactor in the event of a loss of coolant accident. A coolant plenum is integrally formed in each of the individual fuel assemblies that comprise the reactor core. The plenums are each connected to a pressurized source of emergency coolant fluid and means are provided to discharge the fluid from the plenums into the adjacent regions of the associated fuel assemblies. (Official Gazette)

8532 Protection system for a nuclear reactor. Loose, R.A.; Brown, W.W. (to Westinghouse Electric Corp.). US Patent 3,920,513. 18 Nov 1975. Filed date 18 Apr 1973. 8p.

A description is given of a protection system for a nuclear reactor which prevents reactor power excursions when conditions arise causing rapid cooldown of the reactor coolant, as when a steam break occurs in the supply line to a steam generator-turbine steam circuit, or under other conditions requiring rapid insertion of boric acid into the reactor. A pump having its inlet connected to the reactor primary coolant loop discharges into, or takes suction from, a tank containing a 12 percent boric acid or other neutron absorbing solution, and forces the solution into the remaining legs of the reactor primary cooling loop. Valves on both sides of the tank keep the tank isolated from the reactor when not in use. (Official Gazette)

8533 Pressurized-water coolant nuclear reactor steam generator. Mayer, H.; Schroder, H.J. (to Siemens Aktiengesellschaft). US Patent 3,921,591. 25 Nov 1975. Priority date 26 Jun 1972, German, Federal Republic of (F.R. Germany). 4p.

A description is given of a pressurized-water coolant nuclear reactor steam generator having a vertical housing for the steam generating water and containing an upstanding heat exchanger to which the pressurized-water coolant passes and which is radially surrounded by a guide jacket supporting a water separator on its top. By thermosiphon action the steam generating water flows upward through and around the heat exchanger within the guide chamber to the latter's top from which it flows radially outwardly and downwardly through a down draft space formed between the outside of the jacket and the housing. The water separator discharges separated water downwardly. The housing has a feedwater inlet opening adjacent to the lower portion of the heat exchanger, providing preheating of the introduced feedwater. This preheated feedwater is conveyed by a duct upwardly to a location where it mixes with the water discharged from the water separator. (Official Gazette)

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 8695, 8698, 8700, 8701, 8705, 8710, 8776, 9254

8534 (GA-A—12821-A(Amend.A)) **PCRV design and verification.** Cheung, K.C. (General Atomic Co., San Diego, Calif. (USA)). Oct 1975. vp. (GA-LTR—8(Amend.A)). General Atomic Co., San Diego, CA.

The applicability and validity of the analytical methods, structural model testing, and finite element computer codes used in the design of multi-cavity prestressed concrete reactor vessels (PCRVs) are analyzed. 29 references (auth)

8535 (GA-A—13100) **Three dimensional depletion analysis for the "as built" FSV initial core.** Nirschl, R.J. (General Atomic Co., San Diego, Calif. (USA)). 15 Nov 1975. Contract E(04-3)-633. 105p. Dep. NTIS $5.45.

During fabrication of the initial FSV core fuel elements, some difficulties with assayed quantities of uranium and thorium were encountered. This problem became apparent when about 40 percent of the total fuel rod requirement was in some state of production and about 10 percent of the fuel elements had been assembled. As a result, some of the specified fuel blends were nearing completion and the uranium and/or thorium was 3 to 4 percent too high or low, and some of the already assembled fuel elements were outside the loading tolerances given in the fuel specification. A description is given of the method of resolution of this problem with the minimum perturbation to the fuel production and no loss of integrity on the fuel performance. (auth)

8536 (GA-A—13728) **Neutronic values of U-233 and U-236 in the HTGR.** Rothstein, M.P.; Redding, J.R.; Brogli, R.H.; Asmussen, K.E.; Lane, R.K. (General Atomic Co., San Diego, Calif. (USA)). 6 Nov 1975. Contract E(04-3)-167. 51p. Dep. NTIS $4.00.

The HTGR utilizes thorium as the fertile material and fully enriched uranium as the makeup feed material. The bred U-233 is recovered and continuously recycled. The discharged feed material is recovered and recycled once more through the reactor before being permanently retired. The bred U-233 is a valuable fuel and its intrinsic neutronic worth, i.e., parity is 1.43 times the value of fully enriched U-235. Parasitic neutron absorptions in U-236 are significant and are proportional to the product of the in-core U-236 inventory and the effective cross section of U-236. The reference recycle mode of operation limits the U-236 inventory buildup and minimizes the effective cross section of U-236. The U-236 that gradually builds up in the bred uranium is unshielded and its neutronic parity is typically -0.58 the value of fully enriched U-235. The U-236 produced in the feed uranium elements and recycled once more is heavily shielded and has a value of -0.20 to -0.25 the value of fully enriched U-235. (auth)

8537 (JUL—1238) **Behaviour of tritium in reactor graphites.** Fischer, P.G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Sep 1975. 102p. (In German). Dep. NTIS (US Sales Only) $5.50.

Laboratory experiments on the behavior of tritium and hydrogen in different graphite materials which are interesting for the HTR are described. With the aid of especially developed vacuum devices the diffusion and adsorption kinetics is measured isothermally and by the flash-filament-method. The detection of hydrogen is made by means of a mass spectrometric method. The tritium is measured after catalytic oxidation by liquid-scintillation. An absolute determination of the total content of tritium and hydrogen in the samples is attained by ashing and subsequent analysis of the combustion gases. From the measurements diffusion coefficients and desorption energies are evaluated. When these results are taken into account for the operation of the HTR, it can be stated that the actual tritium inventory is largely determined by the buffer properties of the graphite core. Thus, in the starting phase of HTRs, when higher tritium production rates are to be expected, the coolant gas activity which is responsible for a tritium

permeation through the heat exchangers, remains small. The predominant part of the produced tritium will be obtained in the reprocessing plants. (auth)

8538 (JUL—1241) **Investigations of two packed fiber insulations in a horizontal pressure tube.** Broeckerhoff, P.; Scholz, F. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorbauelemente). Oct 1975. 105p. (In German). Dep. NTIS (US Sales Only) $5.50.

In the High Pressure Gas Tunnel a fiber insulation specially designed for HHT applications was tested in a horizontal pressure tube. Such an insulation is planned or under construction for the pipe system of the HHV-loop. Pressure and temperature of the test gases air and helium were up to about 40 bar and 400°C. Temperatures and heat fluxes in the different sectors indicated satisfactory results. Natural convection, which would have caused a modification of the insulation, appeared to be only weak. Fiber densities of 280 kg/m³ and 400 kg/m³ respectively prevented gas movements, though the cohering gas volume in the insulation was rather big. Pressure gradients caused by the flowing gas did not influence the insulation effect. (auth)

8539 (ORNL-TM—5132) **Crushing strength of HTGR fuel particles.** Lackey, W.J.; Stinton, D.P.; Davis, L.E.; Beatty, R.L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 20p. Dep. NTIS $5.00.

The whole-particle crushing strengths of High-Temperature Gas-Cooled Reactor fertile and fissile coated particles were measured and correlated with fabrication procedures. The crushing strength of Biso-coated fertile particles was increased by the following factors: (1) increasing the outer coating thickness by 10 μm increased strengths by 0.3 lb (1.3 N) for annealed particles and by 0.5 lb (2.2 N) for unannealed particles. (2) An 1800°C postcoating anneal increased strengths by 1 lb (4.4 N) for particles with thick outer coatings and by 2 lb (8.9 N) for particles having thin coatings. (3) Increasing the inner coating density by 0.1 g/cm³ increased strength by 0.6 lb (2.7 N). The crushing strength of Triso-coated fissile particles was proportional to the thickness of the SiC coatings, and strength decreased on annealing by about 0.2 lb (0.9 N) when a porous plate was used to distribute the coating gas and by about 1.5 lb (6.7 N) when a conical gas distributor was used. The strengths of fertile and fissile coated particles as well as uncoated kernels appear adequate to allow fuel fabrication without excessive particle damage. (auth)

8540 (ORNL-TM—5136) **Status report on structural materials of HTGR primary system components.** Rittenhouse, P.L.; Morgan, C.S. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 30p. Dep. NTIS $5.00.

Assessments of the status of technology of high-temperature gas-cooled reactor primary system structural materials and the implications of these in the prediction of component integrity and performance as related to safety are presented. An update of relevant information on the metallic materials used in the primary system is provided along with the results of initial assessment efforts on the core lateral restrain structure and control material components. No new materials-related safety questions of great urgency were encountered in the course of these studies but several items needing further consideration and investigation were identified. Assessment efforts to be undertaken during FY 1976 are described briefly. (auth)

8541 **Advanced nuclear reactors.** Trauger, D.B. (Holifield National Lab., Oak Ridge, TN). *Trans. Am. Nucl. Soc., Suppl.;* **21**: No. 2, Suppl., 22-23(1975).

From Nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975).

See CONF-750928—.

8542 **Pressure vessels having thermal insulation.** Brissaud, J.; Birch, W. (to Technigaz). US Patent 3,920,518. 18 Nov 1975. Priority date 26 Oct 1971, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A description is given of a thermal barrier system for use in a pressure vessel, such as a pre-stressed concrete pressure vessel housing the pressurized primary circuit of a gas-cooled nuclear reactor, in which there is provided a metal liner, stud members fixed to the metal liner, an inner flexible membrane fixed to the stud member, and porous insulation held between the liner and the membrane. (Official Gazette)

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 8541

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 8541, 8652, 8655, 8656, 8657, 8658, 8674, 8678, 8683, 8685, 8687, 8696, 8697, 8702, 8703, 8707, 8708, 8838, 9007, 9351

8543 (AI-ERDA—13160) **Sodium Technology and Cover Gas Seal Development Programs. Quarterly technical progress report, July—September 1975.** Welch, F.H.; Steele, O.P. III; Hill, E. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Nov 1975. Contract AT(04-3)-824. 66p. AT.

Progress is reported in the areas of sodium removal-storage, alcohol process development, alcohol-sodium removal pilot facility, sodium-water reaction products removal, decontamination studies, general seal development, CRBRP rotating plug inflatable seal test, top shield dip seal configuration characteristics, advanced seals and geometry, advanced materials, and gamma irradiation. (DG)

8544 (ANL-CT—74-02) **Assessment of flow-induced vibrations of selected upper plenum components in the hydraulic core mockup.** Mulcahy, T.M.; Turula, P. (Argonne National Lab., Ill. (USA)). Dec 1973. Contract W-31-109-Eng-38. 38p. AT.

The calculated response of the components subject to the parallel flow conditions assumed was found to be small except in the case of the CLIRA when assumed free of core restraint. The small responses calculated for the components subject to the cross flow conditions assumed were indicative of the fact that most of the components were designed such that the vortex shedding frequency was considerably below the lowest structural natural frequency. The exceptional cases where significantly large response was predicted were the CRDM, the Closed Loop Duct free of core restraint, and the LLFM free at the top of the core. 10 references. (auth)

8545 (ANL/RAS—75-39) **Implicit three-dimensional finite-element formulation for the nonlinear structural response of reactor components.** Kulak, R.F.; Belytschko, T.B. (Argonne National Lab., Ill. (USA)). Sep 1975. 70p. Dep. NTIS $4.50.

The formulation of a finite-element procedure for the implicit transient and static analysis of plate/shell type structures in three-dimensional space is described. The triangular plate/shell element can sustain both membrane and bending stresses. Both geometric and material nonlinearities can be treated, and an elastic-plastic material law has been incorporated. The formulation permits the element to undergo arbitrarily large rotations and translations; but, in its present form it is restricted to small strains. The discretized equations of motion are obtained by a stiffness method. An implicit integration algorithm based on trapezoidal integration formulas is used to integrate the discretized equations of motion in time. To ensure numerical stability, an iterative solution procedure with equilibrium checks is used. (auth)

8546 (CENC—1238(Vol.2)) **LMFBR steam generator development: duplex bayonet tube steam generator. Volume II.** DeFur, D.D. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA)). Apr 1975. Contract AT(11-1)-2426. 376p. Dep. NTIS $10.60.

This report represents the culmination of work performed in fulfillment of ERDA Contract AT(11-1)-2426, Task Agreement 2, in which alternate steam generator designs were developed and studied. The basic bayonet tube generator design previously developed by C-E under AEC Contract AT(11-1)-3031 was expanded by incorporating duplex heat transfer tubes to enhance the unit's overall safety and reliability. The effort consisted of providing and evaluating conceptual designs of the evaporator, superheater and reheater components for a large plant LMFBR steam generator (950 MWt per heat transport loop). (auth)

8547 (CONF-751101—47) **LMFBR spent fuel and new fuel inspection and handling.** Youngquist, C.H. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 26p. Dep. NTIS $5.00.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

If the hot cells used for inspection and preparation of liquid metal fast breeder reactor fuel assemblies can be located so that the fuel assemblies can be moved directly to and from the sodium filled decay storage tank, the fuel handling problems can be simplified and a fuel handling machine may be eliminated. The hot cells can also serve as a transfer lock through the outer containment barrier, thereby permitting uninterrupted reactor operation during fuel transfer to and from the decay storage tank. 5 references (auth)

8548 (COO—2245-23) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, March 1, 1975—May 31, 1975.** Todreas, N.E.; Golay, M.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2245. 95p. AT.

Analytical and experimental work on coolant mixing in LMFBR rod bundles and outlet plenum is reported. (JWR)

8549 (CRBRP-PMC—75-04) **Clinch River Breeder Reactor Plant Project: chief executive briefing. Proceedings of the Breeder Reactor Corporation, October 1975 information session, Chicago, Illinois.** (Clinch River Breeder Reactor Plant Project Office, Oak Ridge, Tenn. (USA)). 1975. 39p. (CONF-751028—P1). AT.

From Clinch River Breeder Reactor Project chief executive briefing conference; Chicago, Illinois, USA (Oct 1975).

Included are individual reports dealing with the following topics: ERDA commitment to the breeder program, overall CRBR status, licensing status, engineering status, the CRBR traveling exhibit and demonstration program, project control planning, public relations, and project administration. (DG)

8550 (GA-A—13565) **Gas-Cooled Fast Breeder Reactor. Quarterly progress report, May 1, 1975—July 31, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 2 Oct 1975. Contract E(04-3)-167. 278p. Dep. NTIS $7.60.

Progress is described in the areas of development of GCFR fuel, blanket, and control elements; fuels and materials development; nuclear analysis and reactor physics for GCFR core design; development of the pressure-equalization system for GCFR fuel; structural-thermal-flow tests of core assemblies; an in-pile loop facility test program plan; reactor engineering to assess the thermal, hydraulic, and structural performance of the core and core support structure, development of reactor control-rod, shutdown-rod, and core element locking mechanisms, evaluation of the capability of PCRV internal structures for postaccident fuel containment; evaluation of the pressure-boundary integrity of the prestressed concrete reactor vessel (PCRV); reactor safety; refueling-system development; component development engineering; shielding requirements of the GCFR; and fuel-rod engineering to evaluate the steady-state and transient performance of the GCFR fuel and blanket rods. (auth)

8551 (GEAP—10028-55) **Core engineering fifty-fifth quarterly report, May—July 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Aug 1975. Contract AT(04-3)-893. 40p. AT.

Progress is described for tasks related to Grid Spaced Driver Assembly, Wire-Wrap Assembly Engineering, Core Component, Structural Design Criteria, and Probabilistic Design. (auth)

8552 (GEAP—13771—16) **Critical experiments and analysis sixteenth quarterly report, July—September 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1975. Contract E(04-3)-893. vp. AT.

Current activities and technical progress for the period July through September 1975 are reported for three subtasks. Subtask A covers the technical direction for critical experiments and analysis as applicable to LMFBR commercial plants and the Clinch River Breeder Reactor Plant Benchmark Critical Experiments in ZPPR Assembly 4 and the CRBRP EMC. Subtask B is directed toward the development of LMFBR plant calculational methods that also can be used at the sites of the Clinch River Breeder Reactor to determine the reactor power distribution, reactivity and fuel status, and for consideration of alternative fuel and control management schemes. Subtask C is directed toward the development of nuclear design extrapolation techniques which will allow the extrapolation of nuclear design data from one LMFBR design to another, e.g. extrapolation of critical experiment data to LMFBR. (auth)

8553 (GEAP—14032-3) **Reference fuel studies first semi-annual report, February 1975—July 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Aug 1975. Contract AT(04-3)-893. 40p. AT.

Research progress is reported for the following subtasks: (1) fuel rod chemistry and thermodynamics; and (2) in-reactor behavior of reference structural materials. (JWR)

8554 (LA—6048-PR) **Examination of fast reactor fuels, FBR analytical quality assurance standards and methods, and analytical methods development-irradiation tests. Progress report, April 1—June 30, 1975, and FY 1975.** Baker, R.D. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-Eng-36. 19p. Dep. NTIS $4.00.

The development tests and examination equipment and new analytical chemistry techniques for examining irradiated LMFBR fuel pins are described. Quality assurance requirements for FFTF materials and components are presented. The development of a fuel burnup measurement method and the development of a fuel composition determination method are reviewed. (DCC)

8555 (LA—6114) **CHIT: a cost accounting program for postirradiation examinations of fast breeder reactor materials.** Phillips, J.R.; Dowler, K.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-Eng-36. 32p. Dep. NTIS $4.00.

CHIT is the Los Alamos Scientific Laboratory's cost accounting computer program for nondestructive and destructive examinations of irradiated fuel pins. The program allows immediate retrieval of fuel pin examination information and provides itemized listings for completed and projected fuel pin examinations, detailed cost accounting summaries for each investigator, fuel pin examinations during a specified time interval, and various subsets of the information. CHIT has been in successful operation for the past two years, providing precise information on cost accounting more efficiently than possible with a manual technique. (auth)

8556 (LA—6155-PR) **Examination of fast reactor fuels, FBR analytical quality assurance standards and methods, and analytical methods development-irradiation tests. Progress report, July 1—September 30, 1975.** Baker, R.D. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-Eng-36. 12p. Dep. NTIS $4.00.

Research directed toward the examination and comparison of the effects of neutron irradiation on LMFBR fuel materials and toward the development of analytical quality assurance standards is reported. (JWR)

8557 (ORNL-TM—4936) **LMFBR spent fuel transport: single assembly heat transport test.** Klima, B.B. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. 103p. AT.

The Single Assembly Heat Transport Test Facility operating experience and test data are presented. This facility was set up to test the heat transport of a simulated LMFBR single fuel assembly consisting of 217 stainless steel tubes each of which was individually wrapped with 0.091-in.-diam wire. This assembly failed and was replaced by an assembly with 0.060-in.-wire wrapping. Heat transport was tested using sodium, helium and argon gases, Dowtherm A, and a vacuum. (auth)

8558 (ORNL-TM—5003(Suppl.1)) **Temperature distribution in 19-rod simulated LMFBR fuel assemblies with and without an edge blockage (out-of-reactor test for ANL SLSF P1 experiment). Record of experimental data for fuel failure mockup bundles 5B and 5C.** Fontana, M.H.; Gnadt, P.A.; Kress, T.S.; MacPherson, R.E.; Parsly, L.F.; Wantland, J.L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 67p. AT.

Unevaluated experimental data obtained from Fuel Failure Mockup (FFM) bundles 5B and 5C, which simulated the configuration of the Sodium Loop Safety Facility (SLSF) P1 experiment to be conducted by Argonne National Laboratory (ANL), are presented. The bundles consisted of 19 electric cartridge heaters with outside diameters of 0.23 in. spaced by 0.056-in. wire wraps on a 12-in. pitch. At the edge of the bundles, the diameter of wire wraps was reduced to 0.028 in., so that the flow passages contiguous to the channel wall were reduced in cross-sectional area. In bundle 5B, a stainless steel blockage plate attached 4 in. downstream from the start of the heated section blocked approximately one-third of the flow cross-sectional area along two adjacent flats of the hexagonal duct. During the first portion of the test series, the blockage plate was held flush against the duct wall, while during the latter testing the blockage plate was displaced from the duct wall by 0.014 in. Bundle 5C was an identical configuration except that the blockage plate had been removed from the bundle. The purpose of this test series was to determine the efficacy of the blockage for inducing fuel failure in the SLSF P1 experiment and to preview thermal-hydraulic coolant behavior of the SLSF rod bundle. A description of the system, the experimental procedures, and tabulated data from the experiments performed in this series are included. (auth)

8559 (PB—239513) **Breeder benefits and uranium ore availability. Special report.** Manne, A.S.; Yu, O.S. (Electric Power Research Inst., Palo Alto, Calif. (USA)). 1 Oct 1974. 38p. (EPRI-SR—3). NTIS $3.75.

The relation between economic benefits of the breeder and the availability of uranium ore resources is examined. The model has been constructed around a future role of the fast breeder reactor (FBR) in a mix of nuclear, coal, and other possible advanced concept power systems. Only a small number of variations has been calculated, making assumptions on the cost of uranium, the discount rate for R and D investments, etc. The President of EPRI recommends that, as backup to the FBR, the nation should develop an environmentally acceptable coal utilization technology.

He notes that such a program is now underway, but could become a crucial necessity if uranium ore costs rise substantially, and the FBR or another advanced concept is not available in time. (GRA)

8560 (RT/ING—(75)11) **Full scale tests and thermal design correlations for coiled once-through steam generators.** Campolunghi, F.; Cumo, M.; Ferrari, G.; Palazzi, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jun 1975. 25p. Dep. NTIS (US Sales Only) $3.50.

Full scale heat transfer tests have been performed in a coiled once-through steam generating tube (d/sub tube/ = 0.0155 m, d/sub coil/ = 0.836 m), with subcooled water at inlet and superheated steam at outlet. Pressure (p) ranges from 80 to 170 bar, specific mass flowrate (G) from 1.000 to 2.500 kg/m²sec, surface heat flux (q'') from 10 to 30 x 10^4 W/m². q''/G ratios have been kept almost constant, close to a typical value for LMFBR's steam generators: q''/G approximately equal to 0.13 KJ/kg. It has been deduced that for q''/G less than 0.13 KJ/kg no DNB does occur. Designers may so account for a boiling length extended up to 100 percent quality. Along this length (an important portion of steam generators) a mean boiling heat transfer coefficient is suggested: Dirac constant/sub b/ = 11.226 $q''^{0.6}$. $e^{0.0132}$ anti p [W/m² °C] within a +-30 percent error margin. Internal and external side heat transfer coefficients, in the superheated steam region of the coil, may differ up to 100 percent and more. (auth)

8561 (WARD-OX—3045-6(Vol.2)) **11:1 scale rod bundle flow tests: parts 8 and 9.** Roidt, R.M.; Vegter, B.J.; Pechersky, M.J.; Markley, R.A.; Sherba, P.S. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Oct 1975. Contract E(11-1)-3045. 104p. AT.

The tests include measurements of velocities downstream of blocked subchannels in a model LMFBR rod bundle and measurements of effects of rod bowing on the subchannel flow rate in a model rod bundle. (JWR)

8562 (ANL-Trans—1024) **Heat transmission and pressure drop in the steam generators heated by sodium circulation.** Robin, M.G. Translated from *Rev. Gen. Therm.*; **11**: No. 132, 1189(1972). 40p. Dep. NTIS $4.00.

Heat transfer and pressure drop equations are presented which have received experimental verification from the tests of a liquid metal heated steam generator module of the PHENIX type installed at the Station for Thermal Testing of the C.E.A. at Grand Quevilly. These laws seem valid for the straight tube apparatus (at least on the major part of their developed length) and should all be applicable to the new generator proposed by Stein Industry for the future fast neutron power plant. But again, there will have to be the validation of a whole new ensemble of laws to take into account the helicoidal tubes proposed by Babcock Atlantic for the same application: tests responding to this objective have already been running at Grand-Quevilly for several months. (auth)

8563 (ANL-Trans—1028) **Study of random hydrodynamic vibrations of certain structures in the reactor unit of the Phenix.** Lesueur, C.; Milan, D.; Payan, G. Translated from *Nucl. Eng. Des.*; **18**: No. 2, 279-303(1972). 52p. Dep. NTIS $4.50.

An important source of vibrations in the vessels of a reactor such as the sodium cooled Phenix reactor is the turbulence of the liquid sodium flow. Random pressure pulsations may excite the natural modes of the structures if they are within the low frequency range. Studies were undertaken to ascertain whether the vessels and internals of the reactor were adequately stable and if not, to determine the necessary changes to achieve this aim. The vibrational characteristics of the considered structures were measured on mechanical models at the scales of 1/10 or 1/5 in the air as well as in quiet water simulating sodium. Pressure recordings carried on hydraulic models at the scale of 1/4 were analyzed for the statistical features of the pressure pulsations. The response of the structures was calculated analytically by using the theory of random vibrations of shells. An upper bound of the response was determined by using only the model characteristics and the power spectral density functions. This was sufficient to guarantee the mechanical stability of structures considered, after an eventual stiffening. (auth)

8564 (ANL-Trans—1009) **Changes in the conception of the steam generators and the intermediate exchangers between the Phenix plant and the 1200 MWe plant.** Robin, M.; Perrin, R.; Pouderoux, P.; Tillequin, J. Translated from *Bull. Inf. A.T.E.N.* (*Assoc. Tech. Energ. Nucl.*); No. 96, 15-28(Jul 1972). 30p. Dep. NTIS $5.00.

The numerous studies and tests that are being carried out in France concerning the operation of the intermediate exchangers, and sodium heated steam generators, control functioning, verification of long term behavior and their resistance in case of any incident or accident are described. (auth)

8565 ADVANCED REACTORS: PHYSICS, DESIGN, AND ECONOMICS. PROCEEDINGS OF THE INTERNATIONAL CONFERENCE HELD AT ATLANTA, GEORGIA, SEPTEMBER 8—11, 1974. Kallfelz, J.M.; Karam, R.A. (eds.). Oxford; United Kingdom of Great Britain and Northern Ireland (UK); Pergamon Press Ltd. (1975). 854p. (CONF-740903—). $30.00.

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

Sixty papers are included. Each paper has been separately abstracted and indexed, with fifteen papers listed in previous issues of NSA under Conference No. 740903. (DG)

8566 Current status of the U. S. fast breeder reactor development program. Nemzek, T.A.; Cunningham, G.W. (Energy Research and Development Administration, Washington, DC). pp 68-86 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

A brief description is given of the program for the development of the Liquid Metal Fast Breeder Reactor (LMFBR). Several other breeder concepts are under study by the Division of Reactor Research and Development including the Gas-Cooled Fast Breeder Reactor (GCFBR), and the Molten Salt Breeder Reactor (MSBR). The most recent milestone reached in the U. S. breeder program is initiation of work on the Clinch River Breeder Reactor, which has evolved as a partnership among the AEC, Commonwealth Edison and the Tennessee Valley Authority. It will be the first breeder demonstration plant, have a capacity of 380 MWe, and represent financial contributions in excess of $240 million from about 350 investor and publicly-owned electric utilities. (auth)

8567 Examination of LMFBR power and resource cost projections. Strauch, S. (Energy Research and Development Administration, Washington, DC); Fletcher, J.; Bennett, L. pp 90-104 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

Mining large quantities of uranium from low grade ores may be required if the LMFBR is not introduced at an early date. The environmental and economic costs of obtaining uranium from the low grade ores would be high. With the LMFBR, the utility industry can be essentially independent from mined uranium by the year 2020 and have lower average nuclear power plant fuel cycle costs. (auth)

8568 Implications of recent trends on LMFBR performance characteristics. Hardie, R.W.; Omberg, R.P.; Rothrock, R.B. (Hanford Engineering Development Lab., Richland, WA). pp 153-164 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

It is concluded that the breeding ratio of a 1000 MWe reactor based on a design of the FTR type is about 0.27 lower than that of the conceptual follow-on design. Approximately one-third of this drop is due to cross section changes and the other two-thirds is due to design decisions. These design decisions were conservative since information pertaining to stainless steel swelling and corrosion was limited when the FTR design was fixed. However, programs are currently under way to provide more information on swelling and corrosion rates; this information should allow the designer to increase the fuel volume fraction by reducing either the steel or sodium volume fractions. In addition, it may be possible to improve the doubling time in future oxide-stainless steel LMFBR core designs by techniques such as: increasing the smear density of the fuel, the development of a swelling or creep-resistant alloy, the use of fission gas vents, cold-end plenums, or other design features to reduce the amount of steel and sodium in the core. (auth)

8569 Control rod interaction effects in sodium cooled fast reactors. Daughtry, J.W. (Westinghouse Hanford Co., Richland, WA); Meyer, J.F.; Travelli, A. pp 296-304 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

An experimental and analytical study was performed to investigate the magnitude of control rod interaction effects and to evaluate analytical methods for computing the worths of boron carbide absorber rods when large interaction effects are present.

Experimental results are presented which show that abnormal rod configurations can produce a factor of two changes in rod worths. Computations of rod worths show good agreement with the experimental results. (auth)

8570 Impact of EBR-II tests and operational data on analysis. Meneghetti, D.; Honekamp, J.R. (Argonne National Lab., IL). pp 329-343 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

The importance of EBR-II irradiation test and operational data impact on analysis is discussed and some recent advances and problems are reviewed. (auth)

8571 Physics evaluation of some design changes in the EBR-II. Sehgal, B.R. (Argonne National Lab., IL). pp 344-353 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

Results are presented for the reactor physics analysis of the installation of a higher worth control rod system and a new type metal fuel loading for the EBR-II. (auth)

8572 Implications of integral experiment data to LMFBR design. Zolotar, B.; Beck, C.; Bohn, E.; Grassechi, G.; Kaiser, R.E.; Kier, P.; Simons, G.; Yule, T. (Argonne National Lab., IL). pp 392-401 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

Experiments and calculations from a large variety of experiments have been examined to determine consistency and general trends. Particular attention was paid to basic parameters and to heterogeneity results which are necessary to make extrapolations to power reactor designs. (auth)

8573 Present status of cross section data of the fissile and fertile isotopes for fast reactors. de Saussure, G.; Perez, R.B. (Oak Ridge National Lab., TN). pp 427-451 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

The status of the most relevant neutron cross sections for the design of fast breeder reactors is briefly reviewed. (auth)

8574 Sensitivity studies of the breeding ratio for the Clinch River Breeder Reactor. Kallfelz, J.M. (Georgia Inst. of Tech., Atlanta); Williams, M.L.; Lal, D.; Flanagan, G.F. pp 606-619 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

Generalized perturbation theory has been used to investigate the sensitivity of the breeding ratio for the Clinch River Breeder Reactor to various cross section changes. Model studies to determine a one-dimensional model appropriate for the investigations are described. For a 26-group ENDF/B-III data set, curves which give the sensitivity of the breeding ratio to various fertile and fissile element cross sections are reported and discussed. An example of folding the sensitivity data with an ENDF/B covariance file is given. (auth)

8575 Sensitivity studies of the effects of nuclear data uncertainties for the higher plutonium isotopes upon fast reactor design. McKnight, R.D. (Argonne National Lab., IL); LeSage, L.G.; Christensen, J.M. pp 620-629 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

The sensitivity of LMFBR design parameters to nuclear data uncertainties is investigated. Based on a review of the available cross section literature, the uncertainties in the cross sections of ^{240}Pu, ^{241}Pu, and ^{242}Pu, as well as ^{239}Pu and ^{238}U, are evaluated. The effects of these cross section uncertainties upon reactor parameters are assessed by making uniform cross section adjustments within the range of uncertainties. The sensitivity calculations consider two methods of maintaining the system at critical: (1) by adjusting the core enrichment, and (2) by adjusting the amount of control in the core. The results of these sensitivity calculations are compared with target accuracies for calculation of reactor parameters. These sensitivities are further used to estimate the nuclear data uncertainties which would be allowable to meet the target accuracies. (auth)

8576 Nuclear design of the Clinch River Breeder Reactor system. Buhl, A.R. (Energy Research and Development Administration, Germantown, MD); Riley, D.R.; Dickson, P.W.; Doncals, R.A.; Greebler, P. pp 650-664 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

The nuclear design of the Clinch River Breeder Reactor (CRBR) is proceeding on schedule and is consistent with the fundamental objectives of the first LMFBR (U. S.) Demonstration Plant—namely: (1) safe, reliable, and efficient operation in a normal utility environment and (2) provide a demonstration of the breeding principle. The nuclear design is described by the following generic areas of interest: reactor system design; nuclear data, computation methods, and critical experiments; fuel-blanket management; control considerations; breeding characteristics; nuclear design impact on safety parameters; and core monitoring. (auth)

8577 (ORNL-tr—4004) **One year of Phenix operation.** Conte, F. (CEA Centre de Marcoule, 30 - Bagnols-sur-Ceze (France)). 1975. Translated by M. Gerrard from a French report. (CONF-750411—84). 19p. Dep. NTIS $4.25.

From European nuclear conference; Paris, France (21 Apr 1975).

The operations carried out since the first coupling of the Phenix Station to the grid on Dec. 13, 1973 are described. The last of the tests before putting into service, interspersed with periods of work and which were terminated July 14, 1974, are also described. From this latter date, the system was in use with developments taking place without major incident. This chronological description is accompanied by diagrams for times up until the end of March 1975, production statistics, main operating variables at different states, and a summary of the incidents that have occurred during use. The chief subassemblies of the station are reviewed with details of possible incidents, modifications made, and partial conclusions that can be drawn. In particular, problems of fuel, block reactor structures, sodium pumps, clad rupture detection, steam generators, sodium circuits, and energy production installations are enumerated. In general, performance of the installation and values predicted have been in good agreement. Fuel handling was the objective of a special study, rather brief because of the few incidents encountered. The handling techniques used are described chronologically and the modifications introduced are reviewed. Dismantling and transfer in the processing plant of the first irradiated fuels are indicated. (auth)

8578 (AEC-tr—7295, pp 39-44) **Experimental power station with gas-cooled fast reactor and dissociating heat-transfer medium (BRG-20).** Krasin, A.K.; Nesterenko, V.B.; Kolykhan, L.I.; Bubnov, V.P.; Il'in, A.Ya.; Slizov, V.P.; Shufrov, Yu.V. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Design parameters and a schematic diagram are presented for a N_2O_4 cooled fast reactor. The reactor is visualized as a 20MW(t) prototype of a large power plant and the basic construction is similar to the sodium-cooled BOR-60 reactor. (HDR)

8579 (BNWL-tr—161) **Ultrasonic sweep arm for sodium-cooled reactors.** Rohrbacher H.A.; Bartholomay, R. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Nov 1975. Translation of KFK—2117. 25p. Dep. NTIS $3.00.

Experience is described in the use of a new type of monitoring and testing device to be applied in conjunction with components under sodium. In the method outlined, ultrasonic pulses are used which are emitted into the sodium plenum of fast breeder reactors by newly developed high temperature transducers. The basic work was conducted under out-of-pile conditions in a sodium tank of the sodium tank facility of the Karlsruhe Institute for Reactor Development. The sensor development, which preceded this phase, resulted in the use of soldered lithium niobate crystals

whose operating characteristics were improved by the preliminary treatment outlined in the report. Special materials and techniques suitable for sensor fabrication are proposed. An alternative to soldering is suggested for contacting the crystals with their diaphragms, i.e., a contact pressure concept for the range of application up to 2 MHz. (auth)

8580 Shield plug access enclosure for a nuclear reactor. Sutherland, J.P. (to Westinghouse Electric Corp.). US Patent 3,920,512. 18 Nov 1975. Filed date 17 Apr 1973. 6p.

A description is given of a shield plug of a liquid metal cooled fast breeder reactor which uses a hot cell refueling system and has a metal access enclosure sealed to its upper surface. The enclosure contains the control rod drive mechanisms, reactor closure bolts and other components as are generally mounted on a shield plug, and an air atmosphere is provided within the enclosure. A horizontally extending bellows-like structure allows personnel access to the enclosure from the exterior of the hot cell. (Official Gazette)

8581 Nuclear reactor instrumentation. Duncombe, E.; McGonigal, G. (to United Kingdom Atomic Energy Authority). US Patent 3,922,192. 25 Nov 1975. Priority date 1 Nov 1972, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A liquid metal cooled nuclear reactor is described which has an equal number of fuel sub-assemblies and sensing instruments. Each instrument senses temperature and rate of coolant flow of a coolant derived from a group of three sub-assemblies so that an abnormal value for one sub-assembly will be indicated on three instruments thereby providing for redundancy of up to two of the three instruments. The abnormal value may be a precurser to unstable boiling of coolant. (Official Gazette)

8582 Clinch River Breeder Reactor breeding characteristics. Tillett, G.C. Jr.; Buhl, A.R. (Energy Research and Development Administration, Washington, DC). *Nucl. Technol.;* **28**: No. 1, 92-97(Jan 1976).

The compound system doubling time of the Clinch River Breeder Reactor has been evaluated for a broad range of breeding ratios and fuel cycle parameters. Reprocessing plant fissile inventory and fissile losses due to incomplete fuel recovery are shown to have a strong influence on the doubling time when the breeding ratio is low. If the breeding ratio is above 1.2, fissile losses are much less significant and acceptable doubling times are achieved. (auth)

8583 Statistical and metallurgical analyses of experimental Mark-IA driver fuel element cladding failures in the Experimental Breeder Reactor II. Olson, N.J.; Walter, C.M.; Beck, W.N. (Argonne National Lab., Idaho Falls, Idaho). *Nucl. Technol.;* **28**: No. 1, 134-151(Jan 1976).

A reasonably large number (39) of Mark-IA driver fuel cladding failures have been obtained from run-to-failure experiments in the Experimental Breeder Reactor II over the past few years. These experiments were designed to yield failure information for various design variables and to qualify the fuel element design to a burnup limit such that the risk of an end-of-design-life failure was exceedingly small for normal operating conditions. None of the design variables or operating conditions tested had a significant effect on the failure statistics. (auth)

8584 Anaysis of pressure pulse generation due to gas release from failed fuel pins in a Liquid-Metal Fast Breeder Reactor. Kazimi, M.S. (Brookhaven National Lab., Upton, NY). *Nucl. Sci. Eng.;* **59**: No. 1, 1-11(Jan 1976).

A model for the analysis of pressure pulse generation due to sudden gas release from failed pins in a liquid-metal fast breeder reactor is presented. The predictions of the model are compared to experimental data on sudden gas release in the ducts of the Experimental Breeder Reactor II. The predicted magnitudes of pressure pulses are in good agreement with the experimental observations. The predicted pressure pulse, however, seems to decay at a faster rate than the experimentally observed rate. The effects of the pin internal pressure upon rupture, the rupture area, and the amount of compressed gas are studied parametrically. The pressure pulse magnitude is found to be more sensitive to the internal pin pressure upon rupture than to either the rupture area or the compressed gas volume. (auth)

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REGULATION AND LICENSING

8585 (CONF-740341—P2, pp vp Paper 17) **Changing face of licensing.** Salvatori, R.; Giglio, J.M. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

The regulatory review process for nuclear power plants is described. Some of the problems and their near-term solutions are examined. The status of some technical issues, including ATWS, ECCS acceptance criteria, and reactor vessel integrity, is discussed. (JWR)

8586 (CPC—1(Rev.3)(Vol 1)) **Quality assurance program manual for nuclear power plants. Volume I. Policies.** (Consumers Power Co., Jackson, Mich. (USA)). 1 Dec 1975. 140p. Consumers Power Co., Jackson, MI.

Policies and procedures are presented which comply with current NRC regulatory requirements and industry codes and standards in effect during the design, procurement, construction, testing, operation, refueling, maintenance, repair and modification activities associated with nuclear power plants. Specific NRC and industry documents that contain the requirements, including the issue dates in effect, are identified in each nuclear power plant's Safety Analysis Report. The requirements established by these documents form the basis for the Consumers Power Quality Assurance Program, which is implemented to control those structures, systems, components and operational safety actions listed in each nuclear power plant's Quality List (Q-List). As additional and revised requirements are issued by the NRC and professional organizations involved in nuclear activities, they will be reviewed for their impact on this manual, and changes will be made where considered necessary. (auth)

8587 (NRCI—75/10) **Nuclear Regulatory Commission issuances, October 1975.** (Nuclear Regulatory Commission, Washington, D.C. (USA)). Dec 1975. 101p. TIC $4.00.

Issuances of the Atomic Safety and Licensing Appeal Boards and the Atomic Safety and Licensing Boards are presented. No Nuclear Regulatory Commission issuances were submitted. (HDR)

8588 (NRCI—75/11) **Nuclear Regulatory Commission issuances, November 1975.** (Nuclear Regulatory Commission, Washington, D.C. (USA)). Jan 1976. 118p. TIC $3.25.

Issuances received from the Atomic Safety and Licensing Appeal Boards and the Atomic Safety and Licensing Boards are presented. (DCC)

8589 (ORNL—5046, pp 93-95) **Application of ALAP concept to light-water reactors.** Dickson, H.W.; Kanduc, M.P.; Cottrell, W.D. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

A program to investigate the means by which the radiation exposure of workers at operating light water reactors can be reduced to the lowest practical levels is discussed. Doses in man-rems are given for a refueling outage at Pilgrim Nuclear Power Station and for a partial refueling outage at Big Rock Point Nuclear Power Station. (GHT)

8590 (RDT-INDEX—1-76(Suppl.)) **Index of RDT Standards.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). 5 Jan 1976. RSO.

An index of new and revised RDT Standards is presented. (DCC)

8591 (RDT-STATUS—(10-75)) **Bimonthly status report of RDT standards.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). Oct 1975. 42p. RSO.

8592 (REG/G—1.35(Rev.2)) **Inservice inspection of ungrouted tendons in prestressed concrete containment structures.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Jan 1976. 4p. NUREG.

8593 (REG/G—10.1(1-75)) **Compilation of reporting requirements for persons subject to AEC regulations.** (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jan 1975. 13p. NUREG.

This guide presents a compilation of all reporting requirements applicable to the various types of AEC licensees and other persons subject to AEC regulations, including identification of the proper AEC addressee or addressees and designation of the number of copies required. (auth)

8594 (WASH—1341 and (Amend.1)) **Programmatic information for the licensing of standardized nuclear power plants.** (USAEC Regulation Directorate of Licensing, Washington, D.C.). Aug 1974. 65p. Dep. NTIS $4.50.

Additional guidance is presented by the Regulatory staff regarding the implementation of Options 1 (standard design) and 2 (duplicate plants) of the AEC's standardization policy for nuclear power plants. A discussion of the standardization policy is included, and the various aspects of the Regulatory processing of standard designs and duplicate plant designs are described. The current status of standardization application submittals is discussed. (auth)

ECONOMICS

8595 (CONF-740341—P2, pp vp Paper 8) **Economic considerations of generation planning.** Skooglund, J.W. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

Some aspects of integrated operation of electric power systems that are of importance to system planning are examined. Faults in the use of milk/kWh comparisons in evaluating the relative economics of nuclear and conventional power plants are pointed out. An accurate technique for making such comparisons is discussed. The economic integration of nuclear units with other types is also discussed. (JWR)

8596 (IEA—75-3) **Net energy from nuclear power.** Rotty, R.M.; Perry, A.M.; Reister, D.B. (Institute for Energy Analysis, Oak Ridge, Tenn. (USA)). Nov 1975. 133p. Dep. NTIS $6.00.

An analysis of net energy from nuclear power plants is dependent on a large number of variables and assumptions. The energy requirements as they relate to reactor type, concentration of uranium in the ore, enrichment tails assays, and possible recycle of uranium and plutonium were examined. Specifically, four reactor types were considered: pressurized water reactor, boiling water reactor, high temperature gas-cooled reactor, and heavy water reactor (CANDU). The energy requirements of systems employing both conventional (current) ores with uranium concentration of 0.176 percent and Chattanooga Shales with uranium concentration of 0.006 percent were determined. Data were given for no recycle, uranium recycle only, and uranium plus plutonium recycle. Starting with the energy requirements in the mining process and continuing through fuel reprocessing and waste storage, an evaluation of both electrical energy requirements and thermal energy requirements of each process was made. All of the energy, direct and indirect, required by the processing of uranium in order to produce electrical power was obtained by adding the quantities for the individual processes. The energy inputs required for the operation of a nuclear power system for an assumed life of approximately 30 years are tabulated for nine example cases. The input requirements were based on the production of 197,100,000 MWH(e), i.e., the operation of a 1000 MW(e) plant for 30 years with an average plant factor of 0.75. Both electrical requirements and thermal energy requirements are tabulated, and it should be emphasized that both quantities are needed. It was found that the electricity generated far exceeded the energy input requirements for all the cases considered. (auth)

CONSTRUCTION AND OPERATION

8597 (PB—239675) **Agro-power-waste water complex for land disposal of waste heat and waste water.** DeWalle, D.R. (Pennsylvania State Univ., University Park (USA). Inst. for Research on Land and Water Resources). Jun 1974. 208p. NTIS $7.25.

An Agro-Power-Waste Water Complex was evaluated as a system in which waste heat from power generation was dissipated by recycling hot water through a pipe network buried in agricultural land. Concurrently, municipal waste water was renovated by sprinkler irrigation on the land and served to maintain a high soil moisture content and soil thermal conductivity. A 0.23 acre field prototype of the Agro-Power-Waste Water Complex was constructed and measurements were obtained of soil temperature, soil thermal conductivity, heat dissipation, degree of waste water renovation, soil surface temperature used in a system analysis. The systems analysis indicated 4500 acres of land with 2-in diameter pipe buried at 1-ft depth and 2-ft spacing in sandy soil would be required for a 1500 MWe nuclear electric plant. A nuclear fuel penalty concept was used in comparing this system with conventional heat dissipation systems. The preliminary results of a system design and cost analysis indicated the concept was less expensive than dry-cooling towers but more expensive than wet-cooling towers. (GRA)

8598 (AEC-tr—7295, pp 130-136) **Part-load performance of power stations with chemically reacting working fluid.** Mikhal'tsev, V.E.; Surovtsev, I.G.; Yakavlev, V.Ya. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Regulation of the power output of a power station operating with N_2O_4 as the working fluid is examined. The efficiencies of two regulation methods are compared. It is concluded that regulation by reducing the inlet temperature of gas to the turbine is less economical than maintaining constant turbine inlet temperatures but transferring a portion of the working fluid to accumulators. (HDR)

8599 (AEC-tr—7295, pp 137-142) **Optimization of the process of shut-down cooling of reactor.** Sharovarov, G.A.; Sadchikov, V.I. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

An optimum after-heat removal system is proposed to assure minimum energy requirements for the system. Equations are presented for determining the time dependent coolant flow rates through the core and the heat exchanger circuit. (HD

8600 (AEC-tr—7295, pp 143-147) **Turbogenerator speed regulation by means of variable-pitch propeller.** Kamenskaya, Zh.V.; Pavlin, I.M.; Sharovarov, G.A. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

A scheme is proposed for the valveless regulation of turbogenerator speed by use of a variable-pitch propeller (VPP) to increase or decrease the turbine power consumed by the propeller. In addition, the VPP serves as a fan to air cool the condenser. (HDR)

FUEL CYCLE

REFER ALSO TO CITATION(S) 8313, 8314, 8315, 8317, 8318, 8319, 8516

8601 (CONF-750867—, pp 130-142) **Simulation methods for nuclear production scheduling.** Miles, W.T.; Markel, L.C. (Systems Control Inc., Palo Alto, CA). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

Recent developments and applications of simulation methods for use in nuclear production scheduling and fuel management are reviewed. The unique characteristics of the nuclear fuel cycle as they relate to the overall optimization of a mixed nuclear-fossil system in both the short-and mid-range time frame are described. Emphasis is placed on the various formulations and approaches to the mid-range planning problem, whose objective is the determination of an optimal (least cost) system operation strategy over a multi-year planning horizon. The decomposition of the mid-range problem into power system simulation, reactor core simulation and nuclear fuel management optimization, and system integration models is discussed. Present utility practices, requirements, and research trends are described. 37 references. (auth)

8602 (CONF-751101—54) **Application of the thorium fuel cycle.** Kasten, P.R.; Tobias, M.L. (Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

An economic analysis of the application of the thorium fuel cycle to thermal reactors is presented. (JWR)

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 8117, 8351

NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 10048

8603 (CONF-750515—) **Proceedings of the second symposium training of nuclear facility personnel, Gatlinburg, Tennessee, May 11—14, 1975.** (Oak Ridge National Lab., Tenn. (USA); American Nuclear Society, Hinsdale, Ill.; American Nuclear Society, Oak Ridge, Tenn.). May 1975. 347p. Dep. NTIS $10.00.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

Twenty-eight papers are presented. Separate abstracts and indexing were prepared for each paper. (DG)

8604 (CONF-750515—, pp 205-211) **Reactors also involve people.** Hurt, H.B. (Union Carbide Corp., Oak Ridge, TN). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

As the nuclear industry develops it is to be hoped that high quality occupational health programs will evolve along with other sound operational procedures and practices. The immediate involvement of occupational health personnel may well afford a safety factor which will minimize the likelihood of either the selection of personnel not adequate for the full responsibilities of their work or the continuation in responsible positions of personnel who develop handicaps of either a physical or mental nature. (auth)

8605 (CONF-750515—, pp 213-223) **Staffing training programs for Commonwealth Edison Company.** Raguse, R.H. (Commonwealth Edison Co., Chicago). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

Included are comments on requirements and qualifications for personnel engaged in training nuclear power plant employees. (DG)

8606 (CONF-750515—, pp 261-270) **Training of engineering support personnel at North Carolina State University.** Bohannon, J.R. Jr. (North Carolina State Univ., Raleigh). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

The sources of planning for the development of curricula for engineering support personnel for the nuclear industry in general and nuclear facilities in particular have included the deliberate acquisition of inputs from employers, feedback from past students, and the critique of curricula by the industry, students, and faculty. As a result, three principal courses were developed in the Department of Nuclear Engineering, namely, Reactor Systems which deals in terms of the design engineer's and owner's concerns with regard to functional requirements, design criteria, and objectives of reactor systems; Reactor Operations which applies the student's basic engineering education to the role of an engineer in nuclear facilities, with particular attention to power plant operations; and Quality Assurance which provides the student with the bases, engineering implications and engineer's role in quality assurance during the design, construction, delivery and operation of nuclear and other complex facilities. A summary of the results to date of this trinity of courses is presented, with particular attention to its acceptance by the industry. (auth)

8607 (CONF-750515—, pp 271-275) **GE autotutorial requalification program.** Howard, D.E. (General Electric Co., San Jose, CA). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

The GE program is broken into eight sections designed to be used at the rate of one per month. Each section starts with a diagnostic examination. The passing grade on this examination is 100 percent. Should an examinee answer any question incorrectly, he must view a short segment of color video tape which will discuss the correct answer to the question, discuss any generic problem indicated by an incorrect answer, and tell him what he must do to update his knowledge in this area of weakness. As part of this update, a series of appendix lectures, also on color video tape, are included which cover generic subject areas such as control rod withdrawal blocks. These lectures are referenced, as applicable, as part of the answers to the diagnostic exam questions. By proceeding through the eight sections in this manner each licensee should be able to update his knowledge as to plant evolutions he seldom, if ever, has to perform. The eight sections of the program cover all phases of plant operation except steady state power operation and cold shutdown. (auth)

8608 (CONF-750515—, pp 293-304) **Training of nonlicensed personnel.** Hetrick, D.E. (GPU Service Corp., Reading, PA). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

The safety and efficiency with which a station operates is a function of the competence and proficiency of all personnel. This includes the nonlicensed personnel who make up the bulk of the station staff. Thus the training of these members of the station complement is an important function in overall station performance. Standards, regulations, regulatory guides, and codes provide guidance to the training requirements for such personnel. Training needs and objectives must be established, a plan prepared and then all incorporated into a training program. A well planned and operated training program will stimulate effective communications between the different groups within the station and between the station and off site support groups. (auth)

8609 (CONF-750515—, pp 305-321) **Survey of maintenance training in power plants in the United States.** Schmidt, W.J. (NUS Corp., Rockville, MD). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

A survey was made to determine the extent of skills training for maintenance personnel in nuclear power stations. Of some 25 nuclear power plants surveyed, skills training is only offered to the maintenance personnel by three utilities. However, it was clear that several utilities already have firm plans to initiate skills training by the end of 1975, and that many others will undoubtedly be offering skills training in 1976. (auth)

8610 (CONF-750515—, pp 323-336) **Developing and scheduling maintenance training programs.** Gammuto, J.J. (Commonwealth Edison Co., Chicago). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

A description is given of the development and scheduling of maintenance training programs for generating station personnel. The systematic procedure used for course development and the scheduling of training sessions at central and on-site locations are discussed. (auth)

8611 (CONF-750515—, pp 337-342) **Training of quality achieving personnel for the construction of nuclear plants.** Beaudoin, W.H. (Tennessee Valley Authority, Knoxville). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium on training of nuclear facility personnel.

Brief comments are made on TVA activities directed toward the training of construction personnel during the past few years. (DG)

THEORY AND CALCULATION

8612 (BNL-NCS—50451, pp 2-17) **Discrepancies in thermal reactor lattice analysis.** Rothenstein, W. (Brookhaven National Lab., Upton, NY). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Experience gained over recent years has shown that the consistent use of ENDF/B data leads to discrepancies, when the results of analysis of thermal reactor lattices containing Uranium fuel of low enrichment are compared with experiment. Typically the effective multiplication factor is less than unity by one or two

percent, and even as much as three percent for very tight water moderated lattices. Similar trends have been observed by investigators at Winfrith using their multigroup data. The previous studies of clean thermal reactor lattices are reviewed. The principal features of the calculational methods, which make full use of ENDF/B data, are outlined and compared with other treatments specially as regards the resonance capture calculations. The information which can be obtained from comparisons of measured integral lattice parameters and their calculated values is discussed, together with attempts which have been made to use this information to reduce or eliminate the gap between theory and experiment. (auth)

8613 (BNL-NCS—50451, pp 72-80) **Analysis of the "four-fuel" experiments using HAMMER.** Craig, D.S. Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Measurements which have been made at Chalk River on a series of 37 element clusters using different fuels—UO_2, UC, U—Si—Al, and U are described. The cluster geometry was identical for all fuels, the moderator was D_2O and measurements were made using four different coolants—air, D_2O, H_2O, and HB40 (an organic). The Savannah River Laboratory cell code HAMMER and the ENDF/B-IV data for ^{235}U and ^{238}U were used to calculate parameters for these lattices. (auth)

8614 (BNL-NCS—50451, pp 215-221) **Technique for simultaneous adjustment of large nuclear data libraries.** Harris, D.R.; Wilson, W.B. (Los Alamos Scientific Lab., CA). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Adjustment of the nuclear data base to agree with integral observations in design work has been limited in part by problems in the required inversion of matrices. It is shown that this inversion problem can be circumvented and arbitrarily large nuclear data libraries can be adjusted simultaneously when the basic data are uncorrelated. The technique is illustrated by adjusting nuclear data to integral observations made on fast reactor benchmark critical assemblies. 3 tables. (SDF)

8615 (CONF-740341—P2, pp vp Paper 9) **Fundamentals of nuclear reactor physics.** Ferber, R.R. 1974.

From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).

In 1974 electric utility engineering conference. Volume II.

Background material concerning the physics of nuclear fission is reviewed. The controlled chain reaction process in a nuclear reactor is described. An analogy between chemical and nuclear reactors is used for illustrative purposes. (JWR)

8616 (CONF-751071—1) **Application of the FORSS sensitivity code system to fast reactor analysis.** Weisbin, C.R.; Oblow, E.M.; Mynatt, F.R. (Oak Ridge National Lab., Tenn. (USA)). 22 Oct 1975. 22p. Dep. NTIS $4.50.

From Meeting of the cross section evaluation working group; Upton, New York, USA (22 Oct 1975).

The FORSS Sensitivity Analysis Code System is described in terms of its objectives and present capabilities. An example is made of a problem specified by the Processing Methods Testing Subcommittee of the Code Evaluation Working Group, i.e., the determination of integral parameters, sensitivities to cross-section data, methods and data uncertainties, and required cross-section accuracies for an infinite media of ZPR 6/7 core composition. (auth)

8617 (COO—3021-10) **Final report [on solving the multigroup diffusion equations].** Birkhoff, G. (Harvard Univ., Cambridge, Mass. (USA)). 1975. Contract E(11-1)-3021. 5p. Dep. NTIS $3.50.

Progress achieved in the development of variational methods for solving the multigroup neutron diffusion equations is described. An appraisal is made of the extent to which improved variational methods could advantageously replace difference methods currently used. (DG)

8618 (LA—6152-MS) **Neutronic rebalance algorithms for SIMMER.** Soran, P.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-eng-36. 25p. Dep. NTIS $4.00.

Four algorithms to solve the two-dimensional neutronic rebalance equations in SIMMER are investigated. Results of the study are presented which indicate that a matrix decomposition technique with a variable convergence criterion is the best solution algorithm in terms of accuracy and calculational speed. Rebalance numerical stability problems are examined. The results of this study can be applied to other neutron transport codes which use discrete ordinates techniques. (auth)

8619 (AEC-tr—7295) **Dissociating gases as heat-transfer media and working fluids in power installations. Materials of the All-Union conference, January 27—30, 1969.** Krasin, A.K. (ed.). (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). 1975. Translation of Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970. (TT—72-52003; CONF-690130—). 295p. Dep. NTIS $7.60.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

The use of dissociating gases, specifically N_2O_4, Al_2Cl_6, and Al_2Br_6, in nuclear power plant primary and secondary coolant circuits is examined. Discussed are the power installations, thermodynamics, heat transfer, and gas-dynamics of the working fluids. A separate abstract was prepared for each of the 39 papers. (HDR)

8620 (AEC-tr—7295, pp 3-7) **Prospects of using the dissociating gases in large power stations.** Krasin, A.K. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The potential for use of dissociating gases such as N_2O_4, Al_2Cl_6, and Al_2Br_6 as heat transfer media and working fluids in power plants is discussed. The applications examined include use of these gases in nuclear reactors in either the primary or secondary cooling systems. (HDR)

8621 (AEC-tr—7295, pp 8-23) **Thermodynamic schemes and cycles of APS using the dissociating gases.** Nesterenko, V.B. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The potential for improvement in the thermal efficiency of nuclear power plants by use of dissociating gases as the heat transfer medium is discussed. Prospective dissociating systems are described and their thermodynamic efficiencies are compared. (HDR)

8622 (AEC-tr—7295, pp 24-32) **Some specific features of the physics of fast reactors with dissociating gases as coolants.** Naumov, V.A.; Slizov, V.P. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The basic physics characteristics of dissociating gas cooled (N_2O_4 and Al_2Cl_6) reactors are compared with those of sodium cooled reactors for various core sizes. Physics characteristics of 1000 MW(e) reactors with various heat transfer media are also examined. (HDR)

8623 (AEC-tr—7295, pp 33-38) **Prospects of using the dissociating gases as heat-transfer media in fast nuclear reactors.** Nesterenko, V.B.; Tverkovkin, B.E.; Shinkevich, O.S. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The physics and thermodynamic characteristics of water-cooled and sodium-cooled fast reactors are compared with those of fast reactors cooled by N_2O_4, Al_2Cl_6, and Al_2Br_6. (HDR)

8624 (AEC-tr—7295, pp 45-48) **Effect of heat of chemical reaction on the performance of thermodynamic cycle employing chemicalloy reacting working fluids.** Bubnov, V.P.; Zakharova, I.S.; Razumova, G.A. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The advantages of using chemically reacting mixtures as working fluids in the thermodynamic cycles of nuclear reactors are examined. The effects of the heat of chemical reaction on the efficiency of the gas-turbine cycle and on the vapor cycle are discussed. (HDR)

8625 (AEC-tr—7295, pp 49-56) **Estimation of the thermodynamic effectiveness of cycles working on thermally dissociating fluids.** Gokhshtein, D.P.; Verkhivker, G.P.; Tetel'baum, S.D.; Lebedev, Yu.N.; Grivanova, S.M. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Gas cycles and vapor cycles are examined for use in nuclear power plants. The cycles use N_2O_4 as the working fluid, and their efficiencies are compared with cycles using non-dissociating gases. (HDR)

8626 (AEC-tr—7295, pp 57-64) **Analysis of the performance of thermal power installations with dissociating working fluid.** Popyrin, L.S.; Starostenko, N.N. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The method used in constructing a mathematical model of the vapor cycle of a power reactor is outlined. The heat source is a sodium cooled fast reactor using N_2O_4 in the secondary circuit. Some results of the cycle efficiency calculated with the model are presented. (HDR)

8627 (AEC-tr—7295, pp 65-68) **Thermodynamic analysis of binary cycles with dissociating aluminum chloride as heat-transfer medium and working fluid.** Zinov'ev, A.V.; Matyunin, A.M.; Chernobai, V.A. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The thermodynamics of power reactor cooling systems using Al_2Cl_6 as the working fluid in the primary circuit and N_2O_4 in the secondary circuit are examined. (HDR)

8628 (AEC-tr—7295, pp 69-73) **Binary cycle with dissociating working fluid in the second circuit of APS with sodium-cooled fast reactor ($Na—Al_2Br_6—H_2O$).** Kalafati, D.D.; Borovikova, A.M. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

A BN-350 type reactor is described in which the intermediate sodium circuit is replaced with one using dissociating Al_2Br_6 as the working fluid. The effects of this scheme on the safety and thermodynamics of the reactor are discussed. (HDR)

8629 (AEC-tr—7295, pp 74-80) **Gas turbines with dissociating working fluids.** Lomashev, B.I.; Nesterenko, V.B. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The design and performance characteristics of large stem turbines are compared to those of turbines using N_2O_4, Al_2Cl_6, and Al_2Br_6. (HDR)

8630 (AEC-tr—7295, pp 81-89) **Parameters of turbines for power stations using reacting gases as working fluids.** Mikhal'tsev, V.E.; Danilov, R.E.; Surovtsev, I.G. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The effects of the number of reheats and the velocity coefficients of the turbine stages on the performance of turbines using N_2O_4 as the working fluid are presented. (HDR)

8631 (AEC-tr—7295, pp 90-99) **Experimental study of the thermodynamic cycle with the dissociating gas N_2O_4 in equilibrium $2NO_2$ in equilibrium $aNO+O_2$ as working fluid.** Nesterenko, V.B.; Lomashev, B.I.; Verzhinskaya, A.B.; Kozolovskii, V.G.; Sakovich, A.T. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The reversibility of the dissociating gas cycle using N_2O_4 operating in the range of 20 to 600°C has been studied in the test-bed D-50. An experimental power station, Vulkan, using the N_2O_4 cycle was installed to evaluate the gas turbine and heat transfer components, to develop sealing materials, and to investigate the reversibility of the cycle. The design and operating parameters of these two installations are described. (HDR)

8632 **Transfer matrix treatments for multigroup Monte Carlo calculations: the elimination of ray effects.** Carter, L.L.; Forest, C.A. (Los Alamos Scintific Lab., NM). *Nucl. Sci. Eng.*; **59**: No. 1, 27-45(Jan 1976).

The coefficients of a truncated Legendre series are usually used in multigroup cross-section sets to describe the angular distribution for a group-to-group scattering event. Discrete ordinates codes use the truncated Legendre series because this representation of the scattering angle can be used with the addition theorem to conveniently treat the scattering source term. However, the truncated Legendre series has inherent disadvantages for Monte Carlo calculations. Discussions are presented of the truncated Legendre series representation, a discrete angle representation, a step function representation, and an exact representation that is applicable for isotropic scattering in the center-of-mass system. The three approximate representations use the coefficients of a truncated Legendre series as a working base. A sample problem shows that the step function representation has advantages for multigroup Monte Carlo calculations, and its inclusion as an option in multigroup codes is recommended. (auth)

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 8954, 9007, 9016, 9249, 9250, 9312

8633 (CONF-751137—1) **Summary and accomplishments of the ORNL program for nuclear piping design criteria.** Greenstreet, W.L. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. 14p. Dep. NTIS $4.50.

From Meeting on methods for analyzing piping integrity; Germantown, Maryland, USA (11 Nov 1975).

The ORNL Piping Program was defined and established to develop basic information on the structure behavior of nuclear power plant piping components and to prepare this information in forms suitable for use in design codes and standards. Charts are presented showing the percentage completion of the various program tasks. (DG)

8634 (CONF-751149—1) **Contributions of the ORNL piping program to nuclear piping design codes and standards.** Moore, S.E. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. 11p. Dep. NTIS $4.50.

From Safety technology meeting for analyzing piping integrity; Germantown, Maryland, USA (11 Nov 1975).

The ORNL Piping Program was conceived and established to develop basic information on the structural behavior of nuclear power plant piping components and to prepare this information in forms suitable for use in design analysis and codes and standards. One of the objectives was to develop and qualify stress indices and flexibility factors for direct use in Code-prescribed design analysis methods. Progress in this area is described. (auth)

8635 (CONF-751149—2) **Verification and qualification of inelastic analysis computer programs.** Corum, J.M. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. 8p. Dep. NTIS $4.50.

From Safety technology meeting for analyzing piping integrity; Germantown, Maryland, USA (11 Nov 1975).

The use of computer programs that employ relatively complex constitutive theories and analysis procedures to perform inelastic design calculations introduces questions of validation and acceptance of the analysis results. In order to check the validity of predicted inelastic responses of simple structures made of type 304 stainless steel, comparisons are made between predicted and measured inelastic responses. Results indicate that the basic trends and features of the inelastic responses are predicted with generally good accuracy. (DG)

8636 (HHR—1) **Composite steel panels for tornado missile barrier walls. Topical report.** (Robertson (H.H.) Co., Ambridge, Pa. (USA)). Oct 1975. 40p. H.H. Robertson Co., Ambridge, PA.

A composite steel panel wall system is defined as a wall system with concrete fill sandwiched between two steel layers such that no concrete surface is exposed on the interior or the exterior wall surface. Three full scale missile tests were conducted on two specific composite wall systems. The results of the full scale tests were in good agreement with the finalized theory. The theory is presented, and the acceptance of the theory for design calculations is discussed.

8637 (ORNL—5044(Vol.3)) **Stress analyses of flat plates with attached nozzles. Vol. 3. Experimental stress analyses of a flat plate with two closely spaced nozzles of equal diameter attached.** Bryson, J.W.; Swinson, W.F. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 386p. Dep. NTIS $10.60.

The complete test results for a flat plate with two closely spaced nozzles attached are presented. Test loadings were 1:1, 1:2, and 2:1 biaxial planar tension loadings on the plate, axial thrust loadings applied separately to the nozzles, and bending moment loadings applied to the nozzles both within and normal to the plane of symmetry containing the nozzle axes. The test plate was 36 x 36 x 0.375 in., and the attached nozzles had outer diameters of 2.625 in. and wall thicknesses of 0.250 in. The nozzles were located in the center of the plate with their centers 3.0 in. apart and were considered to be free of weld distortions and irregularities in the junction region. 6 references. (auth)

8638 (AEC-tr—7295, pp 104-108) **Seals and bearings for rotating shafts of APS with dissociating gas as working fluid.** Krevsun, E.P.; Gorodetskii, M.E.; Il'in, A.Ya. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Problems in the development of seals for turbines and pumps using N_2O_4 are discussed, and test results on various types of seals and seal material are described. Plans for testing high-speed bearings are discussed. (HDR)

8639 Seals for sealing a pressure vessel such as a nuclear reactor vessel or the like. Bruns, H.J.; Huelsermann, K.H. (to Deutsche Babcock and Wilcox Aktiengesellschaft). US Patent 3,915,462. 28 Oct 1975. Priority date 14 Sep 1973, German, Federal Republic of (F.R. Germany). 10p.

A description is given of seals for sealing a pressure vessel such as a nuclear reactor vessel, steam boiler vessel, or any other vessel which is desirably sealed against pressure of the type including a housing and a housing closure that present opposed vertical sealing surfaces which define the sides of a channel. The seals of the present invention comprise at least one sealing member disposed in the channel, having at least one stop face, a base portion and two shank portions extending from the base portion to form a groove-like recess. The shank portions are provided with sealing surfaces arranged to mate with the opposed vertical pressure vessel sealing surfaces. A shank-spreading wedge element also disposed in the channel has at least one stop face and is engaged in the groove-like recess with the sealing member and wedge element stop face adjacent to each other. (Official Gazette)

8640 Centrifugal pump assembly for use in nuclear reactor plants or the like. Honold, E.; Ruepp, M. (to Klein, Schanzlin-Becker Aktiengesellschaft). US Patent 3,918,272. 11 Nov 1975. Priority date 16 Dec 1972, German, Federal Republic of (F.R. Germany). 6p.

A description is given of a vertical centrifugal pump assembly for use as a primary recirculating pump in a nuclear reactor plant which has an uppermost shaft which is driven by a motor, a lowermost shaft which drives the impeller of the pump, and an intermediate shaft which is movable axially between the uppermost and lowermost shafts and carries a housing for radial and/or thrust bearings. A rigid coupling between the lowermost shaft and the intermediate shaft is disengaged when the intermediate shaft is lifted to thereby afford access to certain parts of the lowermost shaft. The uppermost shaft can drive the intermediate shaft through the medium of a flexible coupling having coupling elements mounted on the lower end of the uppermost shaft and the upper end of the intermediate shaft, and a distancing sleeve whose internal threads are in permanent mesh with external threads of the two coupling elements. A shroud which surrounds the flexible coupling has a maximum-diameter tubular section rigid with the housing for the bearings, a minimum-diameter tubular section rigid with but detachable from the casing of the motor, and a median tubular section which penetrates into the maximum-diameter section when the intermediate shaft is lifted. When the minimum-diameter section is detached from the casing of the motor, it can be slid, together with the intermediate section, into the maximum-diameter section to thereby afford access to the flexible coupling. The rigid coupling has two coaxial coupling elements which are mounted at the upper end of the pump shaft and the lower end of the intermediate shaft and may have teeth which mate when the intermediate shaft assumes its lower end position in which it can drive the pump. (Official Gazette)

8641 Cooling means for radial bearings in nuclear reactor pumps or the like. Gaffal, K.; Honold, E.; Martens, R. (to Sulzer KSB Kernkraftwerkspumpen GmbH). US Patent 3,918,689. 11 Nov 1975. Priority date 7 Dec 1972, German, Federal Republic of (F.R. Germany). 6p.

A description is given of a pump for circulation of fluid in the interior of a nuclear reactor vessel which has a tubular member which extends upwardly into the vessel and with clearance through an opening in the bottom wall of the vessel. A sleeve-like bearing element has a lower portion received with minimal clearance in the tubular member and an upper portion which defines with the tubular member a first annular clearance having an enlarged ring-shaped upper portion for an auxiliary impeller which is driven by a pump shaft extending with clearance through the tubular member and having a second impeller in the interior of the vessel. The upper portion of the bearing element fixedly receives a bearing sleeve which defines with a cylindrical shield a second annular clearance communicating with a chamber for liquid coolant. The chamber is defined by a first mounting member which is received with clearance in the tubular member and supports the bearing element and a second mounting member which supports the shield and defines with the shaft a third annular clearance adapted to receive coolant through one or more channels in the lower portion of the second mounting member. When the chamber fails to receive a fresh coolant, the auxiliary impeller draws coolant from the lower part of the chamber, through the channel or channels of the second mounting member, through the third clearance, through one or more ports in the shield, through the second clearance, and into the upper portion of the first clearance. (Official Gazette)

8642 Method and apparatus for testing closed-end tubes in heat exchangers of nuclear reactors and the like. Seyd, G.; Bergbauer, A.; Paulsen, U. (to Siemens Aktiengesellschaft). US Patent 3,919,880. 18 Nov 1975. Priority date 9 Jun 1971, German, Federal Republic of (F.R. Germany). 6p.

A description is given of a test stopper which is insertable into a tube closed at one end for testing the tightness of the tube with a fluid under pressure, the tube being in a heat exchanger of a nuclear reactor or the like. The test stopper includes a tubular outer jacket that is expandable outwardly to tightly seat the stopper in the tube. The stopper also has front and back end-face members joined to the ends of the outer jacket to define a closed space within the jacket. With the stopper inserted into the tube, the front end-face member and the closed end portion of the tube define a closed inner region of the tube. An inner tubular member, disposed within the outer jacket, partitions the closed space within the jacket into an annular outer chamber and a cylindrical inner chamber. A pressure-fluid supply selectively supplies fluid to the chambers. The outer jacket expands in response to fluid admitted to the annular chamber and the front end-face member has a through bore to admit fluid under pressure to the inner region of the tube. A method of testing of such a tube with a fluid under pressure includes inserting the test stopper into the tube and then expanding the outer jacket of the stopper to seat the stopper firmly in the tube. A fluid under pressure is directed through the stopper and into the closed region defined by the front end-face member of the stopper and the closed end portion of the tube. The pressure of the fluid introduced into this closed region is monitored for detecting a leak in the closed-end tube. (Official Gazette)

8643 Process and apparatus for separating and recovering krypton-85 from exhaust gas of nuclear reactor or the like. Yusa, H.; Kamiya, K.; Murata, T.; Yamaki, H.; Hisatomi, S. (to Hitachi, Ltd.). US Patent 3,922,150. 25 Nov 1975. Priority date 25 Feb 1972, Japan. 16p.

An apparatus is described for separating and recovering radioactive krypton-85 contained in an exhaust gas of a nuclear reactor or the like, which comprises a plurality of adsorption beds connected in parallel with respect to a passageway for the exhaust gas, each being packed with activated carbon, wherein adsorption and desorption of krypton-85 in each of the beds are alternatively and repeatedly performed by operating valves disposed between each of the beds and means for reducing pressure in the beds to be desorbed in accordance with a predetermined time schedule. The adsorption and concentration efficiencies are markedly increased by combining the above adsorption apparatus and a distillation apparatus. (Official Gazette)

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 8303, 8305, 9028

8644 (ANL—75-59) **Theoretical assessment of some of the effects of fission-induced impurities on the creep behavior of mixed-oxide fuel.** Singh, R.N. (Argonne National Lab., Ill. (USA)). Oct 1975. Contract W-31-109-Eng-38. 16p. AT.

A theoretical assessment of the effects of solid fission products on the creep behavior of mixed-oxide fuel elements is reported. The effects of fission products on important physical properties of the materials, such as diffusion and dislocation motion, are discussed. These properties are related to creep in terms of (1) the generation of both lattice defects and localized lattice strain and (2) the physical state and location of fission-product clusters. 16 references. (auth)

8645 (BNWL—1955) **Evaluation of the discrepancies between the predicted and experimental effects of xenon and krypton in nuclear fuel rods.** Bradley, D.J.; Hann, C.R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. 31p. Dep. NTIS $4.00.

Discrepancies were noted in GAPCON-THERMAL-1 computer code predictions of the gap conductance when krypton-xenon fill gas mixtures were introduced into the fuel-cladding gap. Noting of the discrepancies sparked an investigation into possible areas of error. GAPCON-THERMAL-1 was checked for its accuracy in calculating fill gas thermal conductivities and viscosities. Results show that the code predictions are within experimental error and minor changes to give more accurate modeling of these fill gas properties would produce only very small effects. The effect of sorbed gas on the gap conductance was studied and the sorbed gas was found to have a significant contribution. The temperature jump distances for various fill gases were examined and a new value suggested for xenon. The use of the new value results in a dramatic increase in gap conductance when the gap size is small. The case of a fuel pellet nonconcentrically positioned in the cladding was considered. A finite element code predicted the effect of the eccentric pellet in terms of a temperature reduction as compared to the concentric pellet case. The asymmetric effect was found to be quite large and dependent on the type of fill gas and amount of eccentricity. The effect of convection in aiding heat transfer was investigated briefly and found to have a negligible contribution for a 0.013-in. diametral gap.

8646 (GEAP—4397) **Post-irradiation examination of ORNL fuel cycle capsules.** Darmitzel, R.W. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Sep 1963. Contract W-7405-eng-26. 68p. Dep. NTIS $4.50.

Post-irradiation examination of fifteen Fuel Cycle capsules was performed at General Electric Company's Vallecitos Atomic Laboratory under contract to Oak Ridge National Laboratory. The capsules contained pelletized and vibratory-compacted ThO_2-4.5% UO_2 fuel material inside type 304 stainless steel cladding. Operations performed at Vallecitos Atomic Laboratory included examination of the claddings, dye penetrant testing, gross gamma activity scanning, fission gas analyses, dimensional measurements, capsule disassembly, dissolution studies, burnup analyses, and metallographic examinations. Examination of the fuel and cladding revealed no evidence of gross change due to irradiation. The fuel material in the pelleted specimen was severely fractured; however, no fuel-cladding reactions, grain growth, or central void formation were observed in this capsule nor in any of the other specimens. Burnup values varied from 0.33 atom percent for Capsule A-1 to 3.80 atom percent for Capsule 730. Fission gas analyses indicated a release of approximately two percent for the capsules containing vibratory-compacted powder.

8647 Fuel assemblies, grapples therefor and fuel transport apparatus for nuclear reactor power plant. Jones, C.R. (to Transfer Systems Inc.). US Patent 3,917,335. 4 Nov 1975. Filed date 25 May 1973. 12p.

A description is given of a nuclear fuel assembly in which vertically disposed fuel elements are spaced within a housing generally of a rectanguloid configuration. Each fuel element includes an upper end plug and lower end plug. Vertically spaced support plates are disposed in the housing with suitable openings to receive the upper and lower end plugs of the fuel elements for supporting the fuel elements with the housing. The upper plate is removable from the housing and the lower fuel plug is detachably connected to the lower plate. Other spacer plates are secured to the housing walls to reinforce same. A grapple having lifting plates with pins enters recesses formed in the housing for enabling the housing to be raised. After the fuel assembly is raised by the grapple, leaf spring retainers of the upper plate are dislodged for removing the upper plate from the housing. Now, the fuel elements can be removed selectively and individually from the fuel assembly by a removal tool. Aligned with and disposed above the removal tool is a transfer casing for housing the selectively removed fuel element while the selectively removed fuel element is transported to and from a fuel reprocessor. (Official Gazette)

8648 Sintered nuclear fuel and method of preparing same. Abate-Daga, G.; Amato, I. (to Fiat Societa per Azioni). US Patent 3,917,768. 4 Nov 1975. Priority date 25 Feb 1969, Italy. 6p.

A description is given of a method of preparing a nuclear fuel containing a consumable nuclear poison uniformly distributed therein in the form of coated micro-spheres of between 10 and 2,000 microns diameter, consisting in preparing sintered micro-spheres of the consumable poison, covering those micro-spheres with a protective coating and incorporating the coated micro-spheres into uranium dioxide powder, followed by sintering. (Official Gazette)

8649 Nuclear reactor fuel assembly. Sasaki, Y.; Tashima, J. (to Tokyo Shibaura Electric Co., Ltd.). US Patent 3,920,517. 18 Nov 1975. Priority date 30 Jun 1970, Japan. 4p.

A description is given of nuclear reactor fuel assemblies arranged in the form of a lattice wherein there is attached to the interface of one of two adjacent fuel assemblies a plate spring having a concave portion curved toward said interface and to the interface of the other fuel assembly a plate spring having a convex portion curved away from said interface. (Official Gazette)

8650 Nuclear reactor fuel assembly arrangement. Kmonk, S.; Sperhac, D.J. (to Westinghouse Electric Corp.). US Patent 3,920,516. 18 Nov 1975. Filed date 25 Sep 1972. 6p.

A description is given of a structural arrangement for a nuclear reactor fuel assembly. Top and bottom support plates, comprising fuel assembly outlet and inlet nozzles respectively, are separated by a plurality of metal tubes. Metal grids which serve to space and support fuel rods containing nuclear fuel are spaced along the length of the metal tubes. The metal grids are structurally attached to the metal tubes by sleeves, made of the same material as the metal tubes, which are spring loaded into the metal grid and spot welded to the metal tubes passing therein. (Official Gazette)

8651 Fuel assembly for a nuclear reactor. Ferrari, H.M.; Miller, D.L.; Tong, L.S. (to Westinghouse Electric Corp.). US Patent 3,920,515. 18 Nov 1975. Filed date 26 Sep 1972. 6p.

A description is given of a fuel assembly including multiple open channel grids for holding fuel rods and control rod guide thimbles in predetermined fixed relationship with each other. Metallic straps are interwoven to form a grid or egg crate configuration having openings which receive the fuel rods and guide thimbles. To properly support and cool the fuel rods near the grid-fuel rod interface, springs and dimples on the grid straps project into each opening, the dimples being oriented in a direction to permit flow of coolant upwardly therethrough. To minimize turbulence in coolant flow, the leading edge of each grid strap is provided with cutout sections which form scallops effective in channeling coolant in a uniform flow path through the network of grid openings. (Official Gazette)

CONTROL SYSTEMS

8652 (ORNL/TM—4828) **Inverse kinetics rod drop measurements with a mockup of the Clinch River Breeder Reactor Shield.** Bullock, J.B.; Mathis, M.V.; Mihalczo, J.T. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 85p. AT.

Results of experiments conducted with the Tower Shielding reactor show that neutron flux measurements made outside the Clinch River Breeder Reactor Shield Mockup provide the same inverse kinetics rod drop determinations of control rod worths as measurements made inside the shield.

8653 (AEC-tr—7295, pp 124-129) **Computer-based automatic control system for large atomic power stations.** Greben'kov, Zh.A.; Saunin, E.V.; Tokar, M.S. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Attempts to develop automatic control of nuclear power plants by use of computer-based integrated systems are examined. The basic functions entrusted to the computer and the main components of the control system are briefly discussed. (HDR)

8654 **Digital nuclear reactor control rod position indication system.** Reid, J.B. (to Westinghouse Electric Corp.). US Patent 3,919,043. 11 Nov 1975. Filed date 17 Oct 1973. 6p.

A description is given of a digital nuclear reactor control rod position indication system employing a plurality of Hall Effect transducers longitudinally spaced along the control rod drive housing. The transducers are individually responsive to a magnetic field generated by a magnetized portion of the control drive rod to respectively provide an output when in substantial proximity to the magnetized rod portion. The transducer outputs are multiplexed to display the relative position of the control rods within the reactor core. (Official Gazette)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8810

8655 (ERDA—1535(Vol.1)) **Final environmental statement, Liquid Metal Fast Breeder Reactor Program. Volume 1.** (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1975. 493p. Dep. NTIS $12.50.

Information is presented under the following section headings: LMFBR program options and their compatibility with the major issues affecting commercial development, Proposed Final Environmental Statement for the LMFBR program, December 1974, WASH-1535, supplemental material, and material relating to Proposed Final Environmental Statement review. (DG)

8656 (ERDA—1535(Vol.2)) **Final environmental statement, Liquid Metal Fast Breeder Reactor Program. Volume 2.** (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1975. 639p. Dep. NTIS $16.25.

Included are copies of fifty-six comment letters on the Proposed Final Environmental Statement together with the ERDA replies to these letters. The letters were received from Federal, State, and local agencies, environmental and public interest groups, members of the academic and industrial communities, and individual citizens. (DG)

8657 (ERDA—1535(Vol.3)) **Final environmental statement, Liquid Metal Fast Breeder Reactor Program. Volume 3.** (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1975. 832p. Dep. NTIS $21.25.

Included are copies of thirty-four comment letters on the Proposed Final Environmental Statement together with the ERDA replies to these letters. The letters were received from Federal, State, and local agencies, environmental and public interest groups, members of the academic and industrial communities, and individual citizens. (DG)

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 9393

8658 (EPA—520/3-75-019) **Radionuclide production, transport, and release from normal operation of liquid-metal-cooled fast breeder reactors.** Erdman, C.A.; Kelly, J.L.; Kirbiyik, M.; Reynolds, A.B. (Virginia Univ., Charlottesville (USA). Dept. of Nuclear Engineering). Nov 1975. Contract 68-01-0547. 238p.

Sources of radioactivity from the normal operation of an LMFBR, and the transport of this radioactivity, were studied. Reliance was placed predominantly on published results although some new calculations were made where needed. Results were normalized to a 1000 MW(e) LMFBR and compared to values for a 1000 MW(e) LWR. Sources of radioactivity which were studied included plutonium and other transuranium elements, fission products, tritium, corrosion products, activation products, and tramp fuel. The study of the transport of radionuclides included reviews of transport of fission products and fuel from failed fuel, behavior of radioactivity in sodium and cold traps, and operation of gaseous radwaste systems. Operating experience for liquid metal cooled reactors relating to radioactivity was reviewed. Included were data from the fast reactors EBR-II, Fermi, SEFOR, Dounreay, Rapsodie, and BR-5, and limited data from the thermal reactors SRE, S8ER, and Hallam. (auth)

RESEARCH, TEST, EXPERIMENTAL, ZERO-POWER, AND TRAINING REACTORS AND SUBCRITICAL ASSEMBLIES

REFER ALSO TO CITATION(S) 8689, 9052

8659 (BNL-NCS—50451, pp 18-28) **Monte Carlo analysis of TRX lattices with ENDF/B version 3 data.** Hardy, J. Jr. Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Four TRX water-moderated lattices of slightly enriched uranium rods have been reanalyzed with consistent ENDF/B Version 3 data by means of the full-range Monte Carlo program RECAP. The following measured lattice parameters were studied: ratio of epithermal-to-thermal ^{238}U capture, ratio of epithermal-to-thermal ^{235}U fissions, ration of ^{238}U captures to ^{235}U fissions, ratio of ^{238}U fissions to ^{235}U fissions, and multiplication factor. In addition to the base calculations, some studies were done to find sensitivity of the TRX lattice parameters to selected variations of cross section data. Finally, additional experimental evidence is afforded by effective ^{238}U capture integrals for isolated rods. Shielded capture integrals were calculated for ^{238}U metal and oxide rods. These are compared with other measurements. (auth)

8660 (BNL-NCS—50451, pp 35-44) **S/sub n/ analysis of the TRX metal lattices with ENDF/B version III data.** Wheeler, F.J. (Aerojet Nuclear Co., Idaho Falls, ID). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Two critical assemblies, designated as thermal-reactor benchmarks TRX-1 and TRX-2 for ENDF/B data testing, were analyzed using the one-dimensional S/sub n/-theory code SCAMP. The two assemblies were simple lattices of aluminum-clad, uranium-metal fuel rods in triangular arrays with D_2O as moderator and reflector. The fuel was low-enriched (1.3 percent ^{235}U), 0.387-inch in diameter and had an active height of 48 inches. The volume ratio of water to uranium was 2.35 for the TRX-1 lattice and 4.02 for TRX-2. Full-core S/sub n/ calculations based on Version III data were performed for these assemblies and the results obtained were compared with the measured values of the multiplication factors, the ratio of epithermal-to-thermal neutron capture in ^{238}U, the ratio of epithermal-to-thermal fission in ^{235}U, the ratio of ^{238}U fission to ^{235}U fission, and the ratio of capture in ^{238}U to fission in ^{235}U. Reaction rates were obtained from a central region of the full-core problems. Multigroup cross sections for the reactor calculation were obtained from S/sub n/ cell calculations with resonance self-shielding calculated using the RABBLE treatment. The results of the analyses are generally consistent with results obtained by other investigators. (auth)

8661 (BNL-NCS—50451, pp 167-188) **Reactivity and reaction rate measurements in U—D_2O lattices with coaxial fuel.** Pellarin, D.J.; Morris, B.M. (E. I. du Pont de Nemours and Co., Aiken, SC). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Material bucklings and reaction rate parameters were measured for heavy water (D_2O) moderated, uniform lattices in the exponential facility (SE-SP) at the Savannah River Laboratory (SRL). Two different slightly enriched, coaxial, uranium fuel assemblies were examined over a wide range of triangular lattice pitches in this study. Results of experiments were compared with RAHAB computations using ENDF/B-IV cross sections. The purpose of this work was to expand the experimental data base to include uniform lattices of coaxial fuel assemblies. Assembly geometry and fuel composition are summarized. Integral parameters are reported for inner and outer fuel separately, providing data for a more detailed and rigorous comparison with computation than previously available. 3 figures, 6 tables. (auth)

8662 (HEDL-TME—74-3(Vol.2)) **HEDL quarterly technical report, July, August, September 1974. Volume 2. Fuels and safety engineering.** Evans, E.A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1974. Contract AT(45-1)-2170. 76p. AT.

Progress is reported in the areas of LMFBR fuels technology and FFTF component fabrication. Extensive data on FFTF component fabrication and testing are presented. (DG)

8663 (HEDL-TME—74-58) **Tag gas burnup based on three-dimensional FTR analysis.** Kidman, R.B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-2170. vp. Dep. NTIS $6.50.

Flux spectra from a three-dimensional diffusion theory analysis of the Fast Test Reactor (FTR) are used to predict gas tag ratio changes, as a function of exposure, for each FTR fuel and absorber subassembly plenum. These flux spectra are also used to predict Xe-125 equilibrium activities in absorber plena in order to assess the feasibility of using Xe-125 gamma rays to detect and distinguish control rod failures from fuel rod failures. Worst case tag burnup changes are used in conjunction with burnup and mass spectrometer uncertainties to establish the minimum spacing of tags which allows the tags to be unambiguously identified.

8664 (HEDL-TME—75-86) **EBR-II 75D, high power dosimetry test.** Lippincott, E.P.; Ulseth, J.A.; Kellogg, L.S.; Davis, A.I.; McElroy, W.N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-2170. 40p. Dep. NTIS $4.25.

Preliminary analysis has been completed for twelve midplane sets irradiated in the EBR-II Run 75D high power dosimetry test. Results indicate changes that have occurred in the EBR-II core environment since previous dosimetry test measurements made before the substitution of the stainless steel reflector for the depleted uranium blanket. Large flux variations were also noted outside the core depending on the composition (fuel vs. structural) of neighboring core subassemblies. (auth)

8665 (LMEC—75-10(Vol.1)) **FFTF SIV qualification test program. Volume I. Description and results.** Miller, D.B. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 15 Aug 1975. Contract AT(04-3)-700. 139p. AT.

A comprehensive test program was conducted on the FFTF 8-in. Secondary Isolation Valve (SIV) to qualify its use in the FFTF system. The tests were performed in the Small Components Test Loop/Piping and Valve Test Insert (SCTL/PVTI) facility at the Liquid Metal Engineering Center (LMEC). Testing has included thermal transients, mechanical cycling, leak checks, flow tests, and operator performance. Physical inspections were conducted in the presodium condition and are planned for the post-sodium condition. (auth)

8666 (ORNL—4865) **Fission product behavior in the Molten Salt Reactor Experiment.** Compere, E.L.; Kirslis, S.S.; Bohlmann, E.G.; Blankenship, F.F.; Grimes, W.R. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 143p. Dep. NTIS $7.60.

Essentially all the fission product data for numerous and varied samples taken during operation of the Molten Salt Reactor Experiment or as part of the examination of specimens removed after particular phases of operation are reported, together with the appropriate inventory or other basis of comparison, and relevant reactor parameters and conditions. Fission product behavior fell into distinct chemical groups. Evidence for fission product behavior during operation over a period of 26 months with ^{235}U fuel (more than 9000 effective full-power hours) was consistent with behavior during operation using ^{233}U fuel over a period of about 15 months (more than 5100 effective full-power hours). (auth)

8667 (ORNL—5046, pp 57-58) **Health Physics Research Reactor and accelerator operations.** Ward, D.R.; Haywood, F.F.; Holland, L.B.; Dickson, H.W.; Jackson, J.E.; Fox, W.F.; Littleton, C.P. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

The Health Physics Research Reactor (HPRR) continues to play an important role in the efforts to correlate radiation dose with biological effects. In addition, the HPRR is also used for nuclear engineering studies and for nuclear safety through the dosimetry intercomparison studies, which are designed to evaluate nuclear accident dosimetry systems. Most of the operation of the DOSAR Low Energy Accelerator has continued in support of an experiment designed to determine the stopping of protons, in the energy range of 50 to 150 keV, in tissue-constituent gases. (auth)

8668 (ORNL-TM—4446) **Calculations of coolant-pipe neutron streaming and secondary coolant activation in the Fast Flux Test Facility.** McGregor, B.J.; Abbott, L.S. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 53p. AT.

Two series of calculations were performed with the DOT discrete ordinates code in two-dimensional cylindrical geometry to predict the neutron streaming along the sodium coolant pipes of the Fast Flux Test Facility to the heat exchanger vault. The results were used to predict the sodium activation that could be expected in the heat exchanger, the criterion for the secondary loop sodium being a maximum of 0.06×10^{-9} Ci/cm^3. The first DOT study was performed in the fall of 1972 for the then-current design of the coolant system for the 28-in.-diam pipe penetrations; the second study was performed in February of 1973 for a later design of both the 28-in. pipe and the 16-in.-diam pipe penetrations. The second study was backed up with a few Monte Carlo calculations performed for more realistic three-dimensional geometries to determine the validity of using the symmetrically cylindrical geometry in the DOT calculations. The results indicated that the DOT calculations were conservative and that even with a factor of 10 uncertainty allowed for the full calculation, the sodium activation in the heat exchanger vault would be less than one-third of its allowed value. (auth)

8669 (ORNL-TM—5216) **Bulk shielding facility quarterly report, April, May, and June of 1975.** Hurt, S.S. III; Lance, E.D.; Thomas, J.R. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 41p. Dep. NTIS $5.00.

The BSR operated at an average power level of 1,722 kw for 37.10 percent of the time during April, May, and June. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The BSR was operated at low and variable power during this quarter for 91.566 hours as part of the training programs for nuclear engineering students from the University of Tennessee and Mississippi State University. The PCA was also used in the above-mentioned training programs and was operated on seven occasions when the University of Kentucky or Mississippi State University students actively participated in training laboratories. (auth)

8670 (ORNL/TM—5269) **Lattice displacement calculations and comparisons for different irradiation facilities.** Kerr, H.T.; Allen, E.J.; Reed, D.L. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 23p. Dep. NTIS $4.00.

Descriptions of lattice displacement parameters are given, and methods for calculating displacement rates are described. Procedures are given for comparing displacement data from different irradiation facilities and effective damage fluence is defined. Values for effective graphite displacement cross sections and neutron fluxes are given for several irradiation facilities.

8671 (ORO—3346-173, pp 24) **Research with fast neutrons from the Georgia Tech reactor.** 31 Oct 1975.

In Nuclear and x-ray spectroscopy with radioactive sources. Eleventh annual progress report, February 1, 1975—January 31, 1976.

Progress in research with fast neutrons from the Georgia Tech reactor using ^6LiD as a source of 14 to 15 MeV neutrons is reported. (SDF)

8672 **European oxide measurements in the Engineering Mockup Critical Assembly of the Fast Test Reactor.** Pond, R.B.; Travelli, A.; Robinson, W.R.; Armani, R.J.; Beitel, J.C. (Argonne National Lab., IL). pp 305-314 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

Worth measurements of Eu_2O_3 and B_4C have been made at the location of a peripheral shim rod, of a control rod, and of a safety rod in the Engineering Mockup Critical (EMC) Assembly of the Fast Test Reactor (FTR). The worths were measured as a function of the volume fraction of control material in the rods over a range from 4 to 32 percent. The measurements indicate that europia is approximately equivalent to natural boron carbide on a reactivity worth per unit volume basis. Calculation of the worths and comparison with the experimental results have also been performed. (auth)

8673 **Evaluation of APPR assembly 3 sodium void experiments.** McFarlane, H.F.; Lineberry, M.J.; Simons, G.G.; Beck, C.L.; Amundson, P.I. (Argonne National Lab., IL). pp 402-411 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

Results are reported of benchmark sodium void experiments and analyses in the ZPPR assembly 3. Comparison of neutronics experiments and analyses in the reference and voided cores are also included. (auth)

8674 ZPPR-4 demo criticals program. LeSage, L.G. (Argonne National Lab., Idaho Falls, ID); Amundson, P.I.; Carpenter, S.G.; McFarlane, H.F.; Lineberry, M.J.; Stewart, S.L.; Hitchcock, J.T. pp 412-421 of In Advanced reactors: physics, design, and economics. Kallfelz, J.M. (ed.). Oxford; Pergamon Press Ltd. (1975).

From Meeting on advanced reactors(physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

See CONF-740903—.

The ZPPR-4 critical assembly was designed to be similar to the Clinch River Breeder Reactor Plant (CRBRP) design in overall shape, configuration and region-average compositions. A four phase program, directed at design input to the CRBRP, blanket performance, blanket fissile buildup effects, full-core breeding performance and plutonium isotopic effects is described. Experimental results for reaction rate distributions in the blanket, control rod and rod group worths and plutonium isotopic effects are discussed. (auth)

8675 (AEC-tr—7295, pp 153-156) **Gas-loop installations working on dissociating heat-transfer medium.** Nesterenko, V.B.; Khorev, V.I.; Kremeshnyi, A.I.; Sokol'chik, V.A. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Two in-pile loop facilities are described for use in research with N_2O_4 as a heat transfer medium. One loop is intended for study of the radiation-thermal stability of N_2O_4, testing construction materials in N_2O_4, and heat transfer properties of N_2O_4 in a radiation environment. The other loop is designed for testing fuel assemblies in N_2O_4. (HDR)

8676 Two-region analysis of pulsing data in fast critical systems. Brunson, G.S.; Huber, R.J. (Argonne National Lab., Idaho Falls, Idaho (USA)). *Nucl. Instrum. Methods;* **128**: No. 2, 379-403(1 Oct 1975).

Pulsed neutron die-away experiments were performed in three fast critical systems assembled in the Argonne Zero Power Reactor-III (ZPR-III). These experiments were part of a comprehensive study of the mockups of the proposed fast reactors FARET (Fast Reactor Test) and SEFOR (Southwest Experimental Fast Oxide Reactor). The two FARET systems pulsed were Assembly 46-B, a 68 liter plutonium—uranium carbide core with stainless steel and sodium reflector; and Assembly 46-C, an 87 liter plutonium—uranium oxide core with the same reflector materials. The SEFOR mockup was a 528 liter plutonium-depleted uranium oxide core with a reflector of stainless steel, sodium and nickel. In all three cases, an acceptable analysis of the die-away curves required two exponentials plus background. From this data, it was possible to assign, by a two-region transfer function analysis, a prompt neutron lifetime to core neutrons and to the system as a whole. Further, the transfer function model used predicts that the die-away curves in the reflector will contain two exponential terms having the same two exponential decay constants as were found in the core, and that the coefficient of the faster decay will be negative. This was found to be the case within experimental uncertainty. (NL)

8677 Power burst facility fuel studies. Cole, J.T. (Aerojet Nuclear Co., Idaho Falls, ID); Wood, R.E. *Nucl. Technol.;* **28**: No. 1, 9-22(Jan 1976).

The Power Burst Facility (PBF) is designed to operate under steady-state conditions to 20 MW (this value may be upgraded to 30 to 40 MW in the near future), with self-limiting power bursts having initial asymptotic periods as short as 1.3 msec, and with shaped power bursts. The core and thus the fuel rods to accomplish these design requirements involved a significant development program to determine the performance capability. The limiting performance capability was determined to be the axial and diametral growth of the fuel rods. The growth behavior of the fuel rods resulted from burst tests conducted in the Transient Reactor Test Facility and Capsule Driver Core reactors. In these tests, the fuel rods were subjected to repeated bursts (10 to 200 bursts/rod) in which fuel temperatures ranged from 1600 to approximately 2600°C. The minimum reactor period was 3.0 msec. The PBF fuel rods, which are 47.5 in. long and 0.75 in. in diameter, experienced maximum axial growth on the order of 0.75 in. and maximum diametral growth of approximately 0.040 in. in these tests. (auth)

8678 (U,Zr)C-graphite fuel for TREAT converter studies. Davidson, K.V. (Los Alamos Scientific Lab., NM). *Nucl. Technol.;* **28**: No. 1, 23-30(Jan 1976).

Improved test facilities are required for safety studies of liquid-metal fast breeder reactor (LMFBR) fuel bundles. The objectives for such a test facility can be obtained by installing a converter section in the central region of the Transient Reactor Test Facility (TREAT) core to provide a hardened neutron spectrum around the test section containing the large cluster of LMFBR fuel pins. The expertise gained at Los Alamos Scientific Laboratory in the Rover fuel element development program was extended to fabricate (U,Zr)C-graphite composite fuel rods for scoping studies of candidate fuels. Selected properties determined for the carbide-graphite composite fuel rods provided for the first scoping test indicate that they are definitely a candidate fuel for a TREAT converter. (auth)

8679 Material property determination for fast pulsed reactor fuels by rapid fission heating. Reuscher, J.A.; Schmidt, T.R. (Sandia Labs., Albuquerque, NM). *Nucl. Technol.;* **28**: No. 1, 57-67(Jan 1976).

A new experimental technique has been developed for dynamically measuring the thermomechanical properties of fissile materials. The speed of sound, modulus of elasticity, and coefficient of thermal expansion as a function of temperature for uranium alloys can be determined using the heating conditions that exist in a fast pulsed reactor. The technique was developed to provide thermomechanical property data for pulse reactor fuels under actual use conditions. (auth)

8680 Measurement of temperature-dependent internal friction for uranium, U—0.78 wt % Ti, U—6 wt % Mo, and U—10 wt % Mo. Laats, E.T. (Idaho State Univ., Pocatello); Schmidt, T.R.; Reuscher, J.A. *Nucl. Technol.;* **28**: No. 1, 68-76(Jan 1976).

Experiments have been performed recently at Sandia Laboratories to investigate and characterize potential fuel materials for fast burst reactors. A novel technique has been developed to determine the thermomechanical properties of fuel materials under actual use conditions. The Sandia Pulsed Reactor II is used to rapidly fission heat a thin rod of the sample material, supported at its center, thereby inducing longitudinal stress waves in the sample. The dilation history at the ends of the rod and the temperature of the rod are recorded. A measure of the internal friction is determined from the decay of the longitudinal oscillations induced in the sample. The materials examined include uranium, U—0.78 wt percent Ti, U—6 wt percent Mo, and U—10 wt percent Mo. The first two are alpha-phase materials in a wrought condition, while the second two are gamma-phase-stabilized materials in an "as cast" condition. The alpha-phase wrought materials had higher internal friction than the gamma-phase "as cast" materials, with uranium being the highest by approximately two orders of magnitude as compared to U—10 wt percent Mo, the lowest. (auth)

8681 Fabrication of uranium—molybdenum alloy fuels for pulsed reactors. Taub, J.M. (Los Alamos Scientific Lab., NM). *Nucl. Technol.;* **28**: No. 1, 77-86(Jan 1976).

The use of pulsed reactors for the evaluation of reactor materials and components has been on the increase, and pulsed reactors to handle large components are under consideration. Pulsed reactors currently operate at a 30 to 50 μsec pulse width and a neutron yield of 5×10^{16} fission/pulse; improved capability would move toward even smaller pulse widths and neutron yields in the 10^{17} fission/pulse range. The gamma phase U—10 Mo alloy with highly enriched uranium has been the fuel alloy used in most pulsed reactors. The fabrication of U—10 Mo alloy fuel plates for the new SPR-III reactor at Sandia Laboratories, Albuquerque, New Mexico, required a detailed review of all processing operations because of the highly enriched uranium and the related criticality considerations. It was necessary to cast the maximum allowable mass of highly enriched uranium (36 kg) in order to make a single fuel plate. The low carbon impurity level specified was obtained with the formulation of a new and highly successful composite coating material for graphite crucibles and molds. The plate distortions which occur in water quenching the alloy from the 950°C gamma phase to room temperature were eliminated by quenching between cold platens in a hydraulic press. Typical mechanical properties obtained on cast, heat treated plates were 930 MPa yield strength, 940 MPa tensile strength, 12.9 percent elongation in 25.4 mm, and 35.4 percent reduction in area. (auth)

8682 Summary of unpublished presentations for fuels for pulsed reactors. Horak, J.A. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **28**: No. 1, 87-91(Jan 1976).

Information is presented on fuels for the IBR-2 reactor, the TREAT converter fuel element studies, the ACPR reactor fuel modifications, and the fuel elements to provide high fluence pulses in the VIPER reactor. (DG)

REACTOR SAFETY

8683 (AI-ERDA—13161) **Nuclear safety characterization of sodium fires and fast reactor fission products. Quarterly technical progress report, July—September 1975.** (Atomics International Div., Canoga Park, Calif. (USA)). 15 Nov 1975. Contract AT(04-3)-824. 24p. Dep. NTIS $4.00.

Progress is reported in the areas of sodium jet dispersal tests, SOMIX code development, aerosol leakage, fuel and fission product release from burning sodium, and properties of high temperature fuel mixture. (DG)

8684 (ANCR—1234) **Experiment data report for Semiscale Mod-1 Test S-02-4 (blowdown heat transfer test).** Crapo, H.S.; Jensen, M.F.; Sackett, K.E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nov 1975. Contract E(10-1)-1375. 94p. Dep. NTIS $5.45.

Recorded test data are presented for Test S-02-4 of the Semiscale Mod-1 blowdown heat transfer test series. Test S-02-4 is one of several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident (LOCA) in a water-cooled nuclear reactor system and to provide data for the assessment of the Loss-of-Fluid Test (LOFT) design basis. Test S-02-4 was conducted from an initial cold leg fluid temperature of 544°F and an initial pressure of 2,263 psia. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with full design core power (1.6 MW). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core. System flow was set to achieve the full design core temperature differential of 66°F. The flow resistance of the intact loop was based on core area scaling. During system depressurization, core power was reduced from the initial level of 1.6 MW in such a manner as to simulate the surface heat flux response of the LOFT nuclear fuel rods until such time that departure from nucleate boiling (DNB) occurs. Blowdown to the pressure suppression system was accomplished without simulated emergency core cooling injection or pressure suppression system coolant spray. The uninterpreted data from Test S-02-4 are presented for future data analysis and test results reporting activities. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and consistent. (auth)

8685 (ANL—75-67) **Physics of reactor safety. Quarterly report, April—June 1975.** (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 16p. Dep. NTIS $4.00.

Reports on reactor safety research and technical coordination of the RSR safety analysis program by members of the Reactor Safety Appraisals Group, Monte Carlo analysis of safety-related critical assembly experiments by members of the Theoretical Fast Reactor Physics Group, and planning of DEMO safety-related critical experiments by members of the Zero Power Reactor (ZPR) Planning and Experiments Group are described. (auth)

8686 (BMI—1940) **Reactor safety program applications and coordination. Task 1. Steam-water mixing program and system hydrodynamics. Quarterly progress report, July—September 1975.** Cudnik, R.A.; Flanigan, L.J.; Denning, R.S. (Battelle Columbus Labs., Ohio (USA)). Nov 1975. Contract W-7405-eng-92. 30p. Dep. NTIS $4.50.

Experimental studies are described which are being conducted to extend the understanding of steam-water interaction phenomena and processes associated with a loss-of-coolant accident. Estimates were made of the degree of steam condensation within the $^{1}/_{15}$-scale, transparent vessel model during penetration studies conducted with and without cold leg steam. The estimates indicated a high degree of steam condensation within the model. The relationship between water penetration to the lower plenum and annulus pressure loss was investigated to assess and quantify, to the extent possible, the effect of ECC water in the annulus on the resistance to reverse core steam flow of the flow system consisting of the power plenum, downcomer annulus, and broken leg. A preliminary correlation for the penetration data obtained without cold leg steam has been obtained and compared with the experimental data. The correlation relates the water penetration to the reverse core steam flow rate, the ECC injection rate, and the ECC water subcooling. The effect on penetration of operating with cold leg steam was quantified. (auth)

8687 (BMI-NUREG—1943) **Effects of radiation on aerosol behavior.** Reed, L.D.; Gieseke, J.A.; Jordan, H. (Battelle Columbus Labs., Ohio (USA)). 18 Dec 1975. Contract W-7405-eng-92. 27p. Dep. NTIS $4.00.

The influence of radioactivity on the behavior of aerosol particles is a subject of potential importance to scientists attempting to predict aerosol concentration levels in containments following postulated nuclear reactor accidents. The purpose of this report is twofold: (1) to postulate, in a general manner, possible physical mechanisms resulting from a particle's radioactivity which may influence its transport, deposition, agglomeration and possible resuspension in accident situations, and (2) to present order of magnitude calculations which demonstrate the importance of each mechanism in aerosol behavior predictions. The influencing mechanisms have been divided into three categories: internal heat generation, momentum exchange effects, and electrical charging effects. Aside from one possible mechanism due to electrical charging effects, each of the physical schemes presented as exerting possible influences on the behavior of aerosol particles in postulated accident situations have been found to be negligible. It is felt that localized "hot spots" within nonconductive dust layers or agglomerates may, in fact, lead to particle ejections. The scheme requires verification that, indeed, localized "hot spots" do exist in the dust layer and that the particles in the "hot spots" retain their charge for a sufficient length of time for the coulombic forces to overcome the London-Van der Waals adhesion forces.

8688 (BNL—50455) **Development of a computer code for thermal hydraulics of reactors (THOR). Second quarterly progress report, January—March 31, 1975.** Wulff, W. (Brookhaven National Lab., Upton, N.Y. (USA)). Apr 1975. Contract AT(30-1)-16. 73p. Dep. NTIS $4.75.

The purpose of the advanced code development work is to construct a computer code for the prediction of thermohydraulic transients in water-cooled nuclear reactor systems. The fundamental formulation of fluid dynamics is to be based on the one-dimensional drift flux model for non-homogeneous, non-equilibrium flows of two-phase mixtures. Particular emphasis is placed on component modeling, automatic prediction of initial steady state conditions, inclusion of one-dimensional transient neutron kinetics, freedom in the selection of computed spatial detail, development of reliable constitutive descriptions, and modular code structure. (auth)

8689 (BNWL-B—451) **Criticality safety review of FFTF interim decay storage tank.** Howes, B.W.; Durst, B.M.; Lewallen, M.A.; Brown, C.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. vp. Dep. NTIS $4.00.

The Interim Decay Storage tank (IDS) will be located in a concrete cell in the FFTF reactor building. The tank will have capacity to store 112 driver fuel assemblies and 10 test assemblies in sodium. A criticality safety analysis for the design of the IDS tank was performed. From the analysis, it is concluded that under normal operating conditions and minor abnormal conditions that might shift the fuel, the IDS tank will remain adequately subcritical. (auth)

8690 (CONF-760202—6) **Application of the ALAP concept to occupational exposure at operating light water reactors.** Dickson, H.W.; Cottrell, W.D.; Jacobs, D.G. (Oak Ridge National Lab., Tenn. (USA)). 1975. 8p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

The application of the as-low-as-practicable (ALAP) concept to radiation exposure of workers at light-water reactors (LWR's) has recently received increased attention. The purpose of the project described is to investigate the means by which occupational exposure at operating LWR's can be reduced to the lowest practicable levels. Nine LWR stations, including 16 operating reactors, were studied in Phase I of the project to identify significant sources of exposure and to determine the magnitude of the exposures. A complete site review consists of compiling information from safety analysis reports, plant technical specifications, and radiation exposure records coupled with an on-site visit for discussions with plant personnel, observation of procedures, and measurement of radiation levels. In Phase II, specific problem areas are being studied in-depth with regard to corrective measures to reduce exposure. Information has been collected on exposure from valve maintenance and repair. Corrective measures will be evaluated with respect to ease of application and cost effectiveness. The results presented will serve as technical backup for the preparation of regulatory guides. (auth)

8691 (COO—2294-2) **Some possible effects of hot walls on flow in PWR downcomers during the ECCS injection phase of a loss of coolant accident, following the end of blowdown.** Wallis, G.B.;

Ludwig, D.L.; Allen, J.E. (Dartmouth Coll., Hanover, N.H. (USA). Thayer School of Engineering). Jun 1975. Contract AT(11-1)-2294. vp. NRC.

The phenomena which may limit the flow rate of a boiling liquid penetrating into a restricted space with walls initially above the saturation temperature are discussed and several "limiting" or "idealized" analyses are presented. Comparison is made with experimental results obtained in small scale apparatus duplicating some of the essential features of the downcomer region of a pressurized water reactor. The possible application of these results for predicting the behavior of large scale tests is discussed. (auth)

8692 (CREARE-TN—217) **ECC delivery study: experimental results and discussion.** Crowley, C.J.; Block, J.A. (Creare, Inc., Hanover, N.H. (USA)). Oct 1975. 130p. Dep. NTIS $6.00.

The results of a series of separate effects and combined effects tests in a $^1/_{18}$-scale planar model of a Pressurized Water Reactor (PWR) downcomer region at or near atmospheric pressure are presented. These tests are part of a continuing effort to develop analytical tools and predictive techniques to permit the calculation of lower plenum filling rates, as a function of time, during a postulated Loss-of-Coolant Accident (LOCA) in PWRs. The effects of reversed core steam flow, cold leg steam flow, and superheated walls on the timing and rate of delivery to the lower plenum of simulated Emergency Core Coolant (ECC) were investigated separately and in various combinations along with variations in the downcomer gap spacing, ECC water temperature, ECC water flow rate, and other parameters. The tests with reversed core steam flow and neutral walls showed that the downcomer gap size does not correlate the results, and also that increased water flow rate or water subcooling resulted in delivery to the lower plenum at higher steam flow rates (and hence earlier in the postulated LOCA transient). Reversed core steam flow and superheated walls combined produced an effect on water delivery which was greater than either effect acting separately. In addition, plenum filling was found not to be an "off-on" process and thus the filling rate as a function of time is the important result from downcomer penetration studies. (auth)

8693 ELECTRIC POWER AND THE CIVIL ENGINEER. CONFERENCE HELD AT BOULDER, COLORADO, AUGUST 12—14, 1974. New York; United States of America (USA); American Society of Civil Engineers (1974). 676p. (CONF-740829—). $10.00.

From ASCE power division specialty conference; Boulder, Colorado, USA (13 Aug 1974).

Twenty-eight papers were presented at the conference. A separate abstract was prepared for two papers for NSA. One of these papers was also abstracted for ERA. Nineteen papers were included in the ERDA energy data base. (RCK)

8694 (ETR—1002) **Design considerations for the protection from the effects of pipe rupture.** (Ebasco Services, Inc., New York (USA)). Nov 1975. 119p. Ebasco Services, Inc., New York, NY.

The methods which are employed by Ebasco Services, Inc. to satisfy the requirement of 10 CFR 50, Appendix A, General Design Criterion (GDC) 4 are discussed. This criterion provides the design basis for protection against the dynamic effects of postulated piping failures (ruptures and cracks) in Nuclear Power Plants. The criteria for postulating pipe failure locations, determining the dynamic effects associated with the postulated failure and designing the plant to satisfactorily withstand postulated pipe failures have been the subject of a great deal of recent work by the nuclear power industry and the Nuclear Regulatory Commission (NRC). This topical report is largely based upon that work as well as upon Ebasco's independent development of analytical tools to aid in the plant design process. (auth)

8695 (GA-A—13617(Vol.2)) **HTGR accident initiation and progression analysis status report. Volume II. AIPA risk assessment methodology.** Fleming, K.N.; Raabe, P.H.; Hannaman, G.W.; Houghton, W.J.; Pfremmer, R.D.; Dombek, F.S. (General Atomic Co., San Diego, Calif. (USA)). Oct 1975. Contract E(04-3)-167. vp. Dep. NTIS $7.60.

A comprehensive summary is presented of the methods and techniques used in risk analyses. Included are discussions of initiating event selection, event tree construction, probability evaluation, consequence evaluation, and presentation of results. (DG)

8696 (GA-A—13703) **GCFR reactor safety progress report, July 1, 1974—June 30, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 12 Dec 1975. Contract E(04-3)-167. 123p. Dep. NTIS $5.45.

A summary of the progress of work performed on a program of safety studies for the GCFR is presented. This work has been directed principally into three areas reported under three separate sections: the first section covers the probabilistic analysis of the accident sequences potentially initiating a loss of in-place coolable core geometry; the second section reports on efforts directed at qualitatively identifying key CDA phenomena; and the third section summarizes analytical efforts directed at characterizing one of these key CDA phenomena, namely the potential for fuel element duct walls melting prior to fuel melting in a shutdown reactor and thus precluding recriticality. (auth)

8697 (GEAP—14038-3) **Advanced safety analysis. Third quarterly report, March—May 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Jun 1975. Contract AT(04-3)-893. 102p. AT.

LMFBR safety-related studies are described concerning engineering analysis of post-accident heat removal, inherently safe core design, fuel pin failure mechanisms, and LMFBR shutdown system reliability goals. (DCC)

8698 (KSC—1037-1) **Reliability analysis of an HTGR SCRAM system including human interfaces. Final report.** Becar, N.J.; Curtis, G.B.; Wood, D.E. (Kaman Sciences Corp., Colorado Springs, Colo. (USA)). Mar 1975. Contract AT(04-3)-1037. 386p. Dep. NTIS $10.60.

The SCRAM Protective System for Fort St. Vrain HTGR power plant has been reviewed in depth using the "GO" reliability analysis technique developed by Kaman Sciences Corporation. A GO logic model of the SCRAM Protective System was created by referencing an intermediate set of logic schematics drawn from numerous detailed system drawings and procedures. Computer analysis of the model provided success probabilities for the various events. Time lines were constructed from the operational and surveillance procedures to define significant points of human interface. The results of the GO analysis indicate that the probability of SCRAM failure is small. Signals from individual SCRAM parameters were evaluated to determine those parameters which might be most effectively improved, if desired, in future reactors. A sensitivity analysis was performed to define the major contributors to system unreliability. Accident scenarios, as submitted by RRD, AEC (ERDA), were evaluated to show the improvement in SCRAM reliability resulting from functional diversity, and to rank the probabilities of successful SCRAM when initiated by the postulated accidents. In the most sensitive areas, results are presented parametrically for ease of extrapolation to newer HTGR designs. (auth)

8699 (LA—6104-MS) **Numerical calculation of flashing from long pipes using a two-field model.** Rivard, W.C.; Torrey, M.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-Eng-36. 13p. Dep. NTIS $4.50.

A two-field model for two-phase flows, in which the vapor and liquid phases have different densities, velocities, and temperatures, has been used to calculate the flashing of water from long pipes. The IMF (Implicit Multifield) technique is used to numerically solve the transient equations that govern the dynamics of each phase. The flow physics is described with finite rate phase transitions, interfacial friction, heat transfer, pipe wall friction, and appropriate state equations. The results of the calculations are compared with measured histories of pressure, temperature, and void fraction. A parameter study indicates the relative sensitivity of the results to the various physical models that are used. (auth)

8700 (LA—6161-PR) **HTGR Safety Research Program progress report, July—September 1975.** Kirk, W.L. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-Eng-36. 49p. Dep. NTIS $5.50.

Information on HTGR safety research is presented concerning fission product release under normal and accident conditions, primary coolant impurities, structural investigation, safety instrumentation and control systems, reactor accident analysis, and phenomena modeling and systems analysis. 72 references. (DCC)

8701 (LA—6224-MS) **Consequence analysis of depressurization accidents.** Foley, J.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Jan 1976. Contract W-7405-ENG-36. 17p. Dep. NTIS $4.50.

The consequences of the depressurization accidents for the High-Temperature Gas-Cooled Reactor are investigated. A consequence model is developed that is used to delineate the parameters that are important to the consequence calculations. A numerical example of the calculational technique is given.

8702 (LA-UR—75-2085) **Possible application of nonredundant pinhole arrays to fuel pin imaging.** Berzins, G.J.; Han, K.S. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-Eng-36. 15p. (CONF-751141—2). Dep. NTIS $4.50.

From Meeting on fuel and clad motion diagnostics in LMFBR safety test facilities; Albuquerque, New Mexico, USA (11 Nov 1975).

LMFBR Safety Test Facility imaging experiments rely on emission of radiation by the fuel pins and thus appear to strongly complement radiographic techniques in that they are most employable during peak excursion—a time of least favorable radiographic signal—to—noise ratio. Radiography, on the other hand, can provide information long before or after the excursion—times of below threshold signal for direct imaging techniques. An underlying premise of any imaging experiment is that, in addition to sufficient brightness, sufficient contrast exists in the scene. A further restriction is imposed by intervening materials, such as the wall of a containment vessel, that not only absorb but also scatter the radiation. These questions are approached by examining the properties of potential recording instrumentation, of pinhole apertures, and of the necessary radiation sources. (auth)

8703 (LA-UR—75-2212) **Simulation of LMFBR test facility conditions with LASL critical assemblies.** Orndoff, J. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-Eng-36. 12p. (CONF-751141—3). Dep. NTIS $4.50.

From Meeting on fuel and clad motion diagnostics in LMFBR safety test facilities; Albuquerque, New Mexico, USA (11 Nov 1975).

Two critical assemblies at LASL are being adapted to simulate LMFBR Safety Test Facility (STF) conditions: (1) the PARKA critical assembly is being modified to serve as a driver for fuel pin arrays at the center for scaled-down simulation of STF; and (2) a moderator geometry adjacent to the Godiva IV prompt burst assembly provides the capability of driving a few fuel pins to instantaneous power levels higher than those expected in STF transients. These simulation facilities are discussed. (auth)

8704 (ORNL—5046, pp 14-52) **Reactor studies.** Barnes, P.R.; Chester, R.O.; Davis, R.R.; Chester, C.V.; Cristy, G.A.; Manweiler, R.W. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

As part of the national Nuclear Energy Center site survey, the effects of national security considerations, of terrorist or sabotage threat, and of natural disasters on the NEC are being studied. Work has been started on the methods and costs of recovery from major accidents under the NEC siting concept. (auth)

8705 (ORNL—5110) **Final report on PCRV thermal cylinder axial tendon failures.** Canonico, D.A.; Griess, J.C.; Robinson, G.C. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 18p. Dep. NTIS $5.00.

The post-test examination of the failed tendons from the PCRV thermal cylinder experiment has been concluded. Failures in the wires are attributed to stress-corrosion cracking. The cause of tendon failures has not been unequivocably established, but they may have been due to nitrates in the duct. The wires employed in the manufacture of the tendons will crack in less than 72 hr in a 0.2 M solution of ammonium nitrate at 70°C. The quality of the wires is poor, and surface cracks were detected. These could have acted as concentrating sites for both stress and the deleterious contaminants. It is believed that the factors that led to the failures in the thermal cylinder experiment were unique. An improper formulation of the epoxy resin did not provide the tendon anchor plate seal that was desired; indeed, the improper formulation is responsible for the high level of nitrogen in the ducts of the failed tendons. (auth)

8706 (ORNL-MIT—62) **Investigation of the consequences of a nuclear reactor core melt-through accident.** Reimer, R.A.; Seidenfeld, A. (Oak Ridge National Lab., Tenn. (USA)). 18 Oct 1968. 42p. Dep. NTIS $4.00.

A core melt-through was assumed to occur in a 3200-Mw(t), water-cooled reactor, and the interactions of the molten fuel material were examined after it had entered the primary containment vessel. It was shown that large quantities of carbon dioxide would be emitted if the core material were allowed to come in contact with limestone aggregate concrete, and that other gases might be emitted if temperatures were high enough. It was also shown that the rate of fission product decay heat production by the core of a 3200 MW(t) reactor would be too great to allow heat removal by any internal mechanism depending finally on conduction through the walls of the primary containment vessel. Several methods of containing the molten core and dissipating the heat were evaluated and some feasible solutions to the problem were presented. (auth)

8707 (ORNL-TM—5076) **LMFBR Safety and Core Systems Programs progress report for April—June 1975.** Fontana, M.H.; Wantland, J.L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 146p. AT.

Progress is summarized in the areas of fluid flow analysis and data evaluation, boiling detection methods development, Fuel Failure Mockup Facility operation, and heater development. (DG)

8708 (ORNL-TM—5145) **Evaluation of the structural integrity of LMFBR equipment cell liners: results of preliminary investigations.** McAfee, W.J.; Sartory, W.K. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 204p. Dep. NTIS $8.75.

The behavior of a plane wall segment of a prototype liquid-metal-cooled fast breeder reactor (LMFBR) cell under conditions of a postulated massive sodium spill was studied. Sodium-concrete reaction calculations were performed assuming an initial flaw existed in the liner such that high-temperature sodium could penetrate to the concrete underneath. Based on existing sodium-concrete reaction rate data, bounding values were established for the maximum energy release per unit volume of concrete. The potential effect of this energy release on the deformation of the liner material was determined. The temperature buildup in the liner and the pressure differential across the flaw in the liner were also studied. The transient thermal and structural responses of the steel liner and backup concrete were analyzed in detail using the inelastic computer code ANSYS. The literature on the mechanical, physical, and general behavior properties of concrete at high temperature was reviewed. This review emphasized the structural behavior of concrete and did not cover the sodium-concrete reaction. (auth)

8709 (ORNL-TM—5178) **Monthly highlights for Office of Nuclear Regulatory Research programs at Oak Ridge National Laboratory.** Fee, G.G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 27p. Dep. NTIS $4.00.

8710 (ORNL-TM—5238) **Monthly progress report for December 1975 for the HTGR safety studies for the Division of Technical Review U.S. Nuclear Regulatory Commission.** Sanders, J.P. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 12p. Dep. NTIS $4.50.

Brief highlights are presented for the following activities: HEXERI code development; FLOOIS code development; analysis of thermal barrier cover plates; and determination of physical property values for helium-air mixtures. (JWR)

8711 (SAND—75-0632) **Light water reactor safety research program. Quarterly report, July—September 1975.** Butcher, B.M. (ed.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 71p. Dep. NTIS $4.50.

Research progress is reported for the molten core—concrete interactions study and for studies on steam explosion phenomena. (JWR)

8712 (XN—75-36NP) **Spray cooling heat transfer phase I test results ENC: 8 x 8 BWR fuel, 60 and 63 active rods. Interim report.** Gaines, S.F.; Leach, C.E.; Barkhurst, D.J. (Exxon Nuclear Co., Richland, Wash. (USA)). 13 Oct 1975. 65p. Exxon Nuclear Co. Inc., Richland, WA.

The first-phase test results of a contemplated two-phase test program are reported. The purpose of the test program is to confirm the spray cooling heat transfer performance of the Exxon Nuclear Company (ENC) 8 x 8 BWR fuel design under conservatively represented loss-of-coolant-accident (LOCA) conditions. The test fuel assembly is a geometric mock-up of the 8 x 8 design with 63 potentially active rods, of which three rods located toward the center can be deactivated to simulate the ENC 8 x 8 design with four centrally located inert rods. The channel and adjacent hardware provide a mockup of the fuel assembly channel/control rod configuration. However, since the thermal boundary conditions as may exist in the reactor during a LOCA are not exactly simulated, the fuel assembly temperature achieved in these tests is not intended to be representative of the expected fuel assembly temperature during a LOCA. The heat transfer coefficients and inert rod wetting front data derived from the tests should be representative of reactor coefficients and wetting because the difference in boundary conditions is taken into account in the models. Wherever possible, conditions expected to exist in the hot assembly during spray cooling have been simulated in the tests. The test results confirm the conservative character of the heat transfer coefficients used in the HUXY analysis of 8 x 8 fuel. (auth)

8713 (XN—75-36NP(Suppl.1)) **Spray cooling heat transfer phase I test results ENC: 8 x 8 BWR fuel, 60 and 63 active rods. Interim report, supplement I.** Gaines, S.F.; Leach, C.E.; Barkhurst, D.J. (Exxon Nuclear Co., Richland, Wash. (USA)). 15 Oct 1975. 27p. Exxon Nuclear Co. Inc., Richland, WA.

Presented in this supplement are results of additional analysis performed on data obtained from the Phase I ENC 8 x 8 Fuel Cooling Test Program. This supplement contains analysis on the steady-state tests, which confirm the use of an average emissivity for stainless steel in the data reduction. Studies are also included on the sensitivity of the PCT and convective coefficients to emis-

sivity. These studies confirm the use of an average emissivity. Correlation of experimentally determined convective coefficients with surface temperature is also reported. (auth)

8714 Seismic analysis and design of the San Onofre Nuclear Generating Station, Units 2 and 3 containment. Wiley, J.W. (Bechtel Power Corp., Norwalk, CA); Schechter, K.M.; Price, D.L.; Koss, P.W. pp 13-40 of In Electric power and the civil engineer. New York; American Society of Civil Engineers (1974).

From ASCE power division specialty conference; Boulder, Colorado, USA (13 Aug 1974).

See CONF-740829—.

Because the San Onofre Nuclear Generating Station, Units 2 and 3, is located in a seismically active western region, design and analysis of the plant had to consider the seismic loads applied to the various safety-related structures, components, and equipment as loads that could control the overall layout and design of the power block. An attempt was made to find an optimum design that would minimize cost penalties associated with these loads, but still provide a high seismic resistant structure. Design and analysis of the containment and interior structure are discussed. Evolution of the containment layout is traced and the analysis procedures for developing in-structure response spectra and the results and the effects of significant parameters are also discussed. (auth)

8715 Soil structure interaction problems for nuclear containment structures. Kausel, E.; Roesset, J.M. pp 469-498 of In Electric power and the civil engineer. New York; American Society of Civil Engineers (1974).

From ASCE power division specialty conference; Boulder, Colorado, USA (13 Aug 1974).

See CONF-740829—.

The problems of soil amplification and soil structure interaction have been the subject of considerable research in recent years, particularly in relation to the seismic design of nuclear power plants. A number of sophisticated mathematical techniques and simpler engineering approximations have been developed to estimate their effects on structural forces, and more importantly, on the characteristics of the motion at different floor levels (amplified response spectra for the design of equipment). There is however some confusion and controversy on the mathematical accuracy of some of these methods and the physical significance of others. Sometimes elaborate techniques are judged appropriate even when based on incorrect assumptions, and often methods which can be shown to be mathematically equivalent are classified as different because of inconsistencies in their implementation. The various methods of analysis now available and their similarities and differences when based on consistent assumptions are examined. (auth)

8716 (ANL-Trans—1030) **Development of the radiological safety studies for French reactors and their sites.** Candes, P. Jul 1975. Translation of CEA-CONF—1877. 25p. Dep. NTIS $3.50.

From International conference on chemical sciences; Paris, France (20 Apr 1971).

See CONF-710444—2.

The study of the safety of large power plants leads to the consideration of all situations, normal or accidental, in which the radioactivity produced in the core is transported by installations in the plant to points where its presence is not desired and to environmental sites where it can reach the population. In order to evaluate these transports, theoretical studies were done to know the transportation to different points in the installation as a function of characteristics or supposed faults of the system. These studies permit evaluation of the radiation levels attained in different parts of the installation and suggest appropriate safety measures. Particular attention is attached to the evaluation of the consequences of an accident and the technical precautionary devices to counter them. The study of the confinement of the installation responds particularly to this goal. (auth)

8717 Nuclear reactor safety: the APS submits its report. (Univ. of California, Santa Barbara). *Phys. Today;* **28**: No. 7, 38-43(Jul 1975).

The summary section of the report by the Study Group on Light-Water Reactor Safety is presented. The American Physical Society group confined itself to the technical issues of the safety of reactors typical of commercial practice in the U. S. A greatly expanded and redirected program in reactor safety research is recommended to reduce the uncertainties identified by the study group. (HDR)

ENERGY STORAGE

MAGNETIC

REFER ALSO TO CITATION(S) 9220, 9293

8718 Wisconsin superconductive energy storage project. Peterson, H.A.; Boom, R.W.; Young, W.C. (Univ. of Wisconsin, Madison). *Proc. Am. Power Conf.;* **37**: 1048-1057(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

In 1970, research effort was initiated at the University of Wisconsin by two Engineering College faculty members to determine the merits of superconductive inductor energy storage units, called I-C (inductor-converter) units, for electric power systems. Interest in the project increased rapidly. The first research proposal was prepared in 1971. The first paper was presented in Kyoto, Japan, at INTERMAG in April 1972. In July 1974, a comprehensive book-length report entitled, "Wisconsin Superconductive Energy Storage Project" Vol. I, was completed which summarized the results of the conceptual design and feasibility studies. It is generally believed in view of this report and related research efforts, particularly at Los Alamos Scientific Laboratories, that superconductive-inductor energy storage for bulk power transmission systems is technically feasible. It is the purpose of this paper to report on recent progress in the design of I-C units and to show how projected costs may be affected.

PUMPED HYDRO

8719 Huntorf: the world's first 290-MW gas turbine air-storage peaking plant. Mattick, W. (Brown Boveri and Co., Mannheim, Ger.); Haddenhorst, H.G.; Weber, O.; Stys, Z.S. *Proc. Am. Power Conf.;* **37**: 322-330(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

A discussion is given of a power system which operates basically on the principle of hydro pumped energy storage and which provides for the transfer of the off-peak energy into the peaking time using a modified gas turbine cycle. The energy is stored as compressed air, released through an expansion valve when needed. Several possible air-storage facilities are discussed. The operation, equipment, and design philosophy are presented for a Huntorf plant now under construction and to be commissioned in 1977. (PMA)

FLYWHEELS

8720 (AECL—5116) **Kinetic energy storage of off-peak electricity.** Simpson, L.A.; Oldaker, I.E.; Stermscheg, J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1975. 72p. Dep. NTIS (US Sales Only) $4.50. AECL $1.50.

The concept of using large flywheels to store off-peak electricity has been considered. The development of high strength composite materials has made possible improvements in the energy storage capacity of such devices. The problems involved in designing large flywheels and their economic advantages over alternative means of energy storage are discussed. The economic arguments are based on the present or near future capabilities and costs of structural composite materials. The flywheel costs turn out to be considerably higher than for many alternative schemes including advanced batteries, gas turbine generators and pumped storage schemes. (auth)

8721 (UCRL—50033-75) **Fiber composite program for flywheel applications. Second quarterly progress report.** Stone, R.G.; Chiao, T.T.; Rinde, J.A.; Penn, L.S.; Clements, L.L.; Chiao, C.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $3.50.

Progress during Sept. to Dec. 1975 in research on the properties of fiber composite materials and methods for fabricating flywheels from these materials is reported. (LCL)

8722 (UCRL—51978) **Mechanical design of a composite centerless flywheel.** Blake, A. (California Univ., Livermore (USA).

Lawrence Livermore Lab.). 16 Dec 1975. Contract W-7405-eng-48. 30p. Dep. NTIS $4.00.

The fundamental design concepts of a ring-type flywheel, preliminary stress formulas, and parametric investigations of behavior of a composite ring in rotation are presented. Preliminary sizing considerations and a structural method of avoiding glass-fiber delamination are emphasized. A brief review of flywheel materials and promising potential applications of flywheel energy storage is included.

CHEMICAL

REFER ALSO TO CITATION(S) 8357, 8358, 8359

BATTERIES

8723 (NTIS/PS—75/649) **Silver cells. A bibliography with abstracts. Search period covered: 1964—August 1975.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Aug 1975. 223p. NTIS $25.00.

Research is presented on silver cell primary and storage batteries with respect to electrochemistry, separators, hermetic seals, electrolytes, electrodes, charging, reliability, and applications. Studies concerning silver—zinc cells and silver—cadmium cells are discussed in the majority of these abstracts. (Contains 172 abstrcts) (auth)

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 8744

8724 (AD/A—008044) **Sulfur-based lithium-organic electrolyte secondary batteries. Quarterly report No. 4, 4 September—3 December 1974.** Holleck, G.L.; Shuker, F.S. (Eic, Inc., Newton, Mass. (USA)). Mar 1975. Contract DAAB07-74-C-0072. 41p. (C—405). NTIS $3.75.

See also AD—003309.

This program is aimed at developing a rechargeable organic-electrolyte lithium battery to operate over the range -40 to +160F, having an energy density approaching 100 Whr/lb, a cycle life in excess of 500, and high charge retention. The approach is to use positive electrodes based on higher sulfides of Nb, Ti and V. Nb and Ti disulfides and trisulfides were prepared thermally. They were characterized by scanning electron microscopy and by x-ray diffraction. Charge--discharge cycles in PC/$LiAlCl_4$ electrolytes are characterized by good reversibility and relatively flat voltage plateaus with mid-discharge potentials of 2.0 V. The discharge mechanism involves a change in the valence of the transition metal. The overall structure of the sulfides influences reversibility strongly during continued cycling. Structure depends on preparation procedures. Molybdenum disulfide is also electrochemically active. (GRA)

8725 (ADB—008547) **Electrical Power Sources Division, quarterly progress notes, 1 July 1975—30 September 1975.** (Defence Research Establishment, Ottawa, Ontario (Canada)). Nov 1975. 61p. (PD—18972). Dep. NTIS (US Sales Only) $4.50.

The Primary Power Sources Section is responsible for carrying out research and development tasks, maintaining expertise and providing technical consultants in the general field of primary power supplies. Subjects of immediate interest include batteries activated by sea water or other saline electrolytes for use in torpedo-propulsion systems, sono(ar)buoys, and distress beacons; unconventional primaries with improved low-temperature performance characteristics for radio transceivers and various types of beacons; and solid-electrolyte systems for fuze battery applications. The Rechargeable Systems Section has responsibilities similar to those of the Primary Power Sources Section, but with respect to secondary batteries and fuel cells. Present investigations include the low-temperature performance of the lead—acid battery, Ni—Cd aircraft battery problems, and the evaluation of the low-temperature performance of fuel cells. This section is also responsible for the studies on nickel—cadmium satellite cells. (RWR)

8726 **Storage battery.** Ikeda, S. (to Yuasa Battery Co., Ltd.). US Patent 3,871,923. 18 Mar 1975. Priority date 14 Dec 1972, Japan. 6p.

This invention relates to a storage battery provided with an improved liquid feeding device and gas exhausting device. This storage battery is formed of a storage battery provided with a monoblock battery container containing such battery elements as plates and separators for each cell and with a novel liquid feeding device and gas exhausting device in a lid. The liquid feeding device has a liquid supplying part communicating with a water tank or an air source and with each cell through an electrolyte level setting tube. The gas exhausting device is formed by containing a valve which closes the passages into each cell at the time of feeding the liquid but can open the above mentioned passage when oxygen and hydrogen gases generated within the storage battery are to be replaced with air fed into each cell from the liquid supplying part. The storage battery of the present invention, by the above mentioned liquid feeding device and gas exhausting device, enables liquid to be safely fed to a fixed level without an explosion within the battery and also allows the operation to be carried out very simply and positively. (auth)

8727 **Negative active substance for a storage cell.** Gabano, J.P.; Jumel, Y. (to Saft-Societe Des Accumulateurs Fixes Et De Traction). US Patent 3,871,917. 18 Mar 1975. Priority date 9 Jun 1972, France. 18p.

The negative active material for a storage cell having an acid electrolyte, whose positive is constituted by the electrochemical system $PbO_2/H_2SO_4/PbSO_4$, is composed of molybdenum oxides such that the average value of the valency be comprised between 4 and 6. The oxides concerned are, more particularly, mixed oxides of MoO_2 and MoO_3. The oxygen reducing system thus obtained may be as follows: $MoO_3 \cdot 4\ MoO_2 + 2H^+ 2e$ in equilibrium $5\ MoO_2 + H_2O$. The corresponding storage cell is characterized by a very low sulphuric acid consumption on discharging and increased stability of the capacity during the idle periods of the storage cell in the charged state. It is recommended to compress the active material before assembly and to apply compression on operation to prevent that substance from disintegrating and scattering. 11 figures. (auth)

8728 **Flat alkaline cell construction and method for assembling the same.** Beatty, T.R.; Vourlis, H. (to Union Carbide Corp.). US Patent 3,871,921. 18 Mar 1975. Filed date 1 Apr 1974. 14p.

A flat alkaline cell is described which comprises an electrode assembly including at least a pair of flat electrode elements of opposite polarity and a porous separator containing the alkaline electrolyte interposed between and in contact with the pair of electrode elements. The electrode assembly is enclosed within a sealed, liquid-impervious plastic film envelope having an opening in one wall thereof and wherein flat internal and external current collectors are disposed adjacent to the inner and outer sides of the wall, respectively, overlying the opening. The collectors are tightly adhered to the respective sides of the wall by thin layers of an adhesive sealant which is non-wettable by the alkaline electrolyte. Means are provided for making electrical connection between the current collectors through the opening in the wall. Also disclosed is a method for assembling the flat cell wherein a composite collector-wall member is formed prior to completion of the sealed envelope. 5 figures. (auth)

8729 **Battery filling device.** Zangrando, R.A. US Patent 3,874,934. 1 Apr 1975. Filed date 8 Mar 1974. 4p.

A battery filling device which, upon manual actuation of a pull ring, automatically transfers liquid electrolyte from a flexible storage container into the cells of a battery. The filling device comprises a housing having chambered sections therein separated by a manifold distributing section. The flexible container and the electrolyte therein are initially contained in an upper chamber. A portion of the container is positioned between the coils of a partially uncoiled portion of a spring metal sheet. The metal sheet is spring formed to roll itself into a cylindrical form when it is unrestrained. The coil is restrained from rolling up upon itself initially by the presence of the filled electrolyte container positioned thereon. Upon actuation of the pull ring, a spring biased valve opens an orifice in the storage container and releases the electrolyte. As the electrolyte disperses through the manifold section to the battery cells located in a lower chamber, the metal sheet coil squeezes the empty section of the flexible container flat so that the spring-biased metal sheet can assume its cylindrical shape by rolling up the flexible container between its coils. The rolling action of the metal sheet helps to squeeze the electrolyte out of the orifice into the distribution manifold. 3 figures. (auth)

8730 **Method of activating storage batteries.** Badger, J.P.; Bernholtz, H.A. (to Eltra Corp.). US Patent 3,884,724. 20 May 1975. Filed date 12 Nov 1970. 6p.

A method of activating a storage battery of the water-activable type is described in which concentrated acid held in semi-solid, granular, or liquid form is placed within the battery by the manufacturer and then, at the point of sale, is released by the addition of water, which combines with the concentrated acid to form the battery electrolyte. The method of this invention utilizes a battery construction in which the stored acid is held in a battery compartment separated from the plates and in which the added water is caused to percolate through the concentrate and is

withheld from contact with the plates for a time sufficient to form a battery electrolyte having a predetermined minimum concentration or specific gravity. (auth)

8731 Storage cell with dissoluble negative line electrodes. Kocherginskii, M.D.; Kalachev, L.; Naumenko, A.; Penkova, L.F. US Patent 3,907,603. 23 Sep 1975. Filed date 15 Aug 1973. 8p.

A storage cell is described which comprises an electrolyte-filled jar in which are disposed dissoluble zinc electrodes and positive electrodes fabricated from oxides of nickel or silver or air-depolarized electrodes, with perforated separators disposed between them. The dissoluble zinc electrodes and positive electrodes are provided with current collectors, the current collectors of the dissoluble zinc electrodes being connected to a means for imparting vibration to the zinc dissoluble electrodes in a manner ensuring mechanical interaction between the whole surface of the dissoluble zinc electrodes and the plastic separators and compaction of the sponge-zinc deposit forming on the electrodes in the course of charging. To provide intensive stirring and accelerate the dissolution of the zinc oxide deposit accumulating on the bottom of the jar in the course of discharging, the ends of the zinc electrodes adjacent to the bottom of the jar are bent at a certain angle or connected in pairs by a perforated plate. The dissoluble zinc electrodes consist of at least two layers, the layer adjacent to the plastic separator having a lesser porosity, while the means for imparting vibration to the dissoluble zinc electrodes is a cam drive. (auth)

8732 Methods for mounting battery plates. Sabatino, A. (to Gould, Inc.). US Patent 3,912,544. 14 Oct 1975. Filed date 12 Nov 1969. 4p.

Battery plates are mounted and aligned in jigs, dipped into a solder bath, and then held in a mold while a lead strap or connecting bracket is cast therein and fused to the plates in one operation. When the lead solidifies, the battery plates are firmly attached thereto. One variation involves dipping the plates in a flux solution before they are dipped in the solder bath. Other variations include subjecting the solder bath or the flux solution to ultrasonic vibrations to enhance the tinning or washing action. 6 figures (auth)

8733 Process for manufacturing storage batteries and battery produced thereby. Sanekata, N.; Hamada, O. (to Yuasa Bettery Company Ltd.). US Patent 3,915,751. 28 Oct 1975. Filed date 8 May 1973. 6p.

This invention relates to a process for manufacturing storage batteries and the batteries produced by such process. The process comprises the steps of inserting anode and cathode plates into a container; inverting the container and embedding the projecting lugs of the anode and cathode plates in a sealing agent disposed in concavities in a cover for the container; sealing the cover on the container; removing respective portions of the cover after the solidification of the sealing agent to present thereby a plurality of cavities, each of which exposes the lugs of corresponding anode plates and cathode plates of adjacent cells to be interconnected; forming connectors for the lugs by filling each cavity with a molten conductive material and allowing the molten material to solidify; and coating the connectors with an insulator. The present invention presents a process which is easily adapted for mass production of inexpensive storage batteries which perform favorably. 4 figures (auth)

8734 Sodium—sulfur cell with improved separator. Kogiso, T.; Hayashi, H. (to Kabushiki Kaisha Toyota Chuo). US Patent 3,915,741. 28 Oct 1975. Priority date 30 Jul 1973, Japan. 10p.

A sodium—sulfur cell having improved safety features and a high level of performance is described. It embodies a solid electrolyte separator with a plurality of elongated small holes extending side by side through the separator in parallel with the major surfaces of the separator. The separator has at least one passage formed therein to function as a reservoir for delivering molten sodium to the elongated holes.

8735 Electric battery. DeRossi, M. (to Consiglio Nazionalle delle Ricerche). US Patent 3,915,744. 28 Oct 1975. Priority date 31 Aug 1971, Switzerland. 12p.

An electric battery is disclosed which comprises a plurality of cells arranged in series. Each cell comprises an aqueous electrolyte of zinc bromide circulated through the cells during charging and discharging, a bipolar electrode having a zinc anode deposited on one side and bromine cathode and active cathodic mass on the other side. The active cathodic mass contains an active cathodic substance which is substantially insoluble in water and which is capable of combining with cathodic bromine to form solid addition products. Additive substances are dissolved in the electrolyte to reduce the solubility of the active cathodic substance, to increase the conductivity and acidity of the electrolyte, and to encourage the zinc to deposit in a thin and uniform layer. 7 figures, 1 table (auth)

8736 System and method for operation of a metal—air secondary battery. Ikeda, H.; Inaba, M.; Ide, M. (to Agency of Industrial Science and Technology). US Patent 3,915,745. 28 Oct 1975. Priority date 9 Dec 1972, Japan. 10p.

The present invention comprises a system for and method of operation of a metal—air secondary battery of an electrolyte circulation type. It comprises a charging circulation system including an electrolyte tank with a large capacity, detachably connectable by a pair of pipe connectors to the apparatus, and a discharging circulation system with a small capacity, these two circulation systems being alternatively changed over by means of a two-circuit, three-way cock. In a charging mode, the body of a metal—air secondary battery is connected to said tank, which is usually installed in a charging station, so that an active metal may be efficiently electrodeposited by using an ordinary circulation method. In a discharging mode, the tank is detached and the battery is connected to the discharging circulation system so that a minimum quantity of electrolyte, necessary for discharging, may be circulated. The system of the present invention is advantageous, therefore, in that the weight and capacity size of a power supply are reduced by half as compared with those of conventional systems, with the result of an improved ratio of energy to weight and size, and is extremely useful when used in a vehicle-borne metal—air battery, for example, an air—zinc battery for an electric automobile. 9 figures (auth)

8737 Sodium—halogen battery. Hess, H.J. (to General Electric Co.). US Patent 3,918,991. 11 Nov 1975. Filed date 20 Sep 1974. 6p.

A sodium—halogen battery is disclosed which comprises a casing, an anode positioned in the casing, a solid sodium ion-conductive electrolyte adjacent to the anode, and a cathode positioned adjacent to the opposite side of the solid electrolyte. The anode consists of sodium in a nonaqueous organic electrolyte of pure 1,2-dimethoxyethane containing a dissolved sodium salt, the salt being selected from the class consisting of sodium perchlorate and sodium bromide. 1 figure, 1 table (auth)

8738 Divalent silver oxide-zinc cell having a unipotential discharge level. Kozawa, A. (to Union Carbide Corp.). US Patent 3,920,478. 18 Nov 1975. Filed date 25 Jun 1974. 10p.

An alkaline silver oxide—zinc cell is described which has a negative electrode, an alkaline electrolyte, a positive electrode comprising divalent silver oxide housed in a positive terminal container, and a separator disposed between the negative electrode and the positive electrode. A discontinuous oxidizable metal, such as a zinc screen, is interposed between the positive electrode and the inner wall of the positive terminal and/or between the positive electrode and the separator so as to achieve a unipotential discharge level on low-drain conditions. 7 figures. (auth)

8739 Electrochemical cells having a liquid alkali metal electrode. Robinson, G.; Jones, I.W. (to Electricity Council). US Patent 3,922,176. 25 Nov 1975. Priority date 3 Jan 1973, United Kingdom of Great Britain and Northern Ireland (UK). 6p.

In an electrochemical cell, such as a sodium—sulfur cell, having a liquid metal electrode and a solid electrolyte, capillary means are provided to draw the liquid metal over one face of the electrolyte, so enabling the whole surface of the electrolyte to be in contact with the metal despite reduction in volume of the metal in the anodic compartment. The capillary means may be constituted by a narrow space between the electrolyte and another member, e.g., a housing, or by fibrous or porous material forming a wick. 9 figures. (auth)

8740 Plural cell battery. Granqvist, C.E. (to Aktiebolaget Tudor). US Patent 3,922,175. 25 Nov 1975. Priority date 14 Dec 1970, Sweden. 8p.

A plural-cell battery composed of a plurality of cells (primary or secondary) is described wherein the electrodes in adjacent cells are rod-shaped comprising a core of a plastic insulating material surrounded by active material in which several electrical leads of conductive material are imbedded. Electrodes of this type may be interconnected by conducting lines which are arranged to pass straight through the common wall between adjacent cells, or may be connected at one end to a pole bridge and thereby form a tubular plate electrode. 10 figures. (auth)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 8379, 8727, 8731, 8732, 8734

8741 (CONF-760112—3) **Lithium requirements for high-energy lithium—aluminum/iron sulfide batteries for load-leveling and electric-vehicle applications.** Chilenskas, A.A.; Bernstein, G.J.; Ivins, R.O. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 19p. Dep. NTIS $3.50.

From Symposium on United States lithium resources and requirements by the year 2000; Lakewood, Colorado, United States of America "USA" (22 Jan 1976).

Lithium—aluminum/iron sulfide batteries are being developed at Argonne National Laboratory for use as energy storage devices on electric utilities and power sources for electric vehicles. These batteries are expected to come into commercial use around 1985 and to achieve rapid market penetration thereafter. By the end of the year 2000 as much as 3% (3 x 10^{8} kW-hr) of the projected total U. S. energy consumption could be supplied by lithium—aluminum/iron sulfide off-peak energy storage batteries. At the same time 18 million electric vehicles or more may be powered by Li—Al/iron sulfide batteries. Projections are made of the quantity of lithium required for lithium—aluminum/iron sulfide batteries produced during 1985—2000. The projected lithium requirement in the year 2000 represents a substantial fraction of the present estimate of world lithium resources, and is nearly equal to the estimated economically recoverable lithium resources in the U. S. In addition, the potential market for primary batteries using lithium will add to these requirements. Expansion of exploration for new sources and increases in production capacity will be needed to meet the projected lithium requirements for the introduction of these batteries in sufficient quantities to produce the desired impact upon petroleum conservation goals in the U. S. transportation sector and electrical power generation. 3 figures, 3 tables. (auth)

8742 (CONF-760312—1) **Electrochemical studies of mass transport in high-temperature electrolytes.** Braunstein, J.; Vallet, C.E. (Oak Ridge National Lab., Tenn. (USA)). 1975. 14p. Dep. NTIS $3.50.

From Battery workshop; Argonne, Illinois, United States of America "USA" (21 Mar 1976).

Since electrode kinetics are rapid for proposed high-temperature batteries, and since the electrolytes are frequently complex or polymeric, mass transfer polarization becomes a limiting factor in recharge rates. Transport parameters needed for design and modeling studies include interdiffusion coefficients and transference numbers. Methods such as chronopotentiometry have been applied almost exclusively to self-diffusion coefficients of dilute constituents. The chronopotentiometric method was developed to provide interdiffusion coefficients over broad ranges of concentration, and the application is illustrated in two kinds of melts: alkali fluoride--beryllium fluoride melts having a polymeric structure, and alkali chloride--aluminum chloride melts having a complex structure. 4 figures, 1 table (auth)

8743 **Negative electrode for electrochemical generator.** Viescou, C. (to Compagnie Industrielle Des Piles Electriques "Cipel"). US Patent 3,871,918. 18 Mar 1975. Priority date 30 May 1972, France. 6p.

An electrochemical storage cell embodying a novel negative electrode of zinc powder grains suspended in a three-dimensional gel constituted by a polymerizing reaction product of acrylamide, acrylic acid, and methylenebisacrylamide; a novel polymer-type electrolyte for this cell; a method of preparing the negative electrode and electrolyte; and a method for producing the cell are described. 3 figures. (auth)

8744 **Battery plate forming apparatus.** Barrett, J.H. Jr. US Patent 3,871,919. 18 Mar 1975. Filed date 24 Sep 1969. 6p.

A battery-plate-forming tank having a removable cover with a filter vent therein to permit the gases generated in the forming process to escape but to condense and retain acid vapors in the tank is described. An adjustable rack is located in the tank for supporting spaced parallel battery plates with their shorter sides vertical and their longer sides horizontal for easy viewing and access. 7 figures. (auth)

8745 **Temperature responsive battery charging circuit.** Peterson, B.E. (to Vapor Corp.). US Patent 3,895,283. 15 Jul 1975. Filed date 26 Nov 1973. 8p.

A battery charging circuit for use in aircraft is described wherein a voltage-regulated alternator is employed to maintain a nickel—cadmium battery charged. A temperature-dependent resistance element thermally coupled to the battery provides a reference voltage against which battery terminal voltage is compared. When the terminal voltage falls below the reference voltage, application of sensing voltage to the alternator voltage regulator is interrupted; this interruption causes full charging current to be applied to the battery. When the terminal voltage exceeds the reference voltage, sensing voltage is reapplied to reduce charging current. The alternator switches between maximum and minimum charging efforts to maintain a voltage level dictated by the battery temperature. 3 figures. (auth)

8746 **Filter cap for storage batteries.** Sundberg, E.G. (to Aktiebolaget Tudor). US Patent 3,899,358. 12 Aug 1975. Filed date 12 Apr 1973. 4p.

A filter cap for a storage battery of the type which gives off gases during its work cycle is described. The filter cap separates droplets of liquid from the gases and allows the droplets to return to the battery. The filter section comprises substantially vertical walls of microporous material that are separated to provide passageways for the released gases. (auth)

8747 **Electrodes including mixed transition metal oxides.** Rinaldi, R.V.; Wynn, J.E. (to Secretary of the Army). US Patent 3,899,357. 12 Aug 1975. Filed date 16 Jul 1973. 4p.

Mixed transition metal oxides are made by a partial reduction of stoichiometric mixtures of the required salts based on the proportion of the metal ion in the oxide being prepared and a firing of the partially reduced mixtures at 800°C in a carbon monoxide-rich atmosphere. The mixed transition metal oxides are used as catalysts in air oxygen cathode structures in practical battery applications. This invention relates to mixed transition metal oxides, to their method of manufacture, and to the use of the oxides as catalysts in air oxygen cathode structures in practical battery applications. 1 table (auth)

8748 **Metal permanganate and metal periodate organic electrolyte cells.** Dey, A.N.; Holmes, R.W. (to P. R. Mallory and Co., Inc.). US Patent 3,904,432. 9 Sep 1975. Filed date 19 Apr 1972. 6p.

A cathodic active material is described which utilizes the permanganates and periodates of heavy metals and preferably of silver. These materials are particularly suitable for use as positive electrodes in nonaqueous electrolyte cells, and such electrodes and the cells are described. A method for fabrication of the active material into cathodes is included. 7 figs, 1 table. (auth)

8749 **Method of manufacturing lead electrodes for storage cells.** Jonville, P.; Stoehr, H.; Beccu, K.D. (to Battelle Memorial Inst.). US Patent 3,907,594. 23 Sep 1975. Priority date 12 Feb 1973, Switzerland. 8p.

A method of manufacturing electrodes for lead storage batteries is described. Molten lead or lead alloy is deposited on a felt of glass fibers by spraying in a molten state to fill the space between the fibers of the felt to form an electrically conductive zone defining electrode contacts. A mass of powdered lead-based material is introduced into the felt by filtration for subsequently producing an active electrode mass by at least one electrochemical transformation. The felt is then cut into individual electrodes. (auth)

8750 **Electrochemical cell and safety resistor therefor.** Bergum, B.C. (to ESB Inc.). US Patent 3,907,588. 23 Sep 1975. Filed date 21 Jan 1970. 8p.

An electrochemical cell is disclosed having a resistive element interposed between a cell electrode and its corresponding terminal. The resistive element acts as a safety resistor, and is a high resistivity material which has a high temperature coefficient of resistance. The element significantly lessens the high flash amperage current which is characteristic of some electrochemical cells, such as nickel—cadmium cells. The resistance of the element preferably has a value as determined in accordance with the equation R/sub a/ = E/I/sub p/ - E/I/sub i/, where R/sub a/ is the ohmic value of the element, E is the open circuit voltage of the cell, I/sub i/ is the initial flash current of the cell in the absence of the element, and I/sub p/ is the flash current of the cell with element present in the cell. 2 figures, 1 table (auth)

8751 **Electrical battery.** Groby, C.; Crafoord, C.G.; Grieves, J. (to Aktiebolaget Tudor). US Patent 3,910,800. 7 Oct 1975. Filed date 4 Jun 1974. 4p.

An electric storage battery having a handle formed as a subassembly to allow one or two persons to carry the battery is described. The sub-assembly includes an intermediate member that has a surface which is secured along the mid-section of the battery cover and one or more upwardly extending arms which carry hinges to which the handles are attached. The handles are shaped to cover the terminal posts. The filler caps are attached to bars which are also mounted to the ends of the intermediate member by means of hinges. 7 figures (auth)

8752 **Alkaline storage battery and zinc negative electrode therefor.** Enters, R.F. (to McGraw-Edison Co.). US Patent 3,918,990. 11 Nov 1975. Filed date 25 Oct 1974. 4p.

An alkaline-electrolyte storage battery having nickel and zinc active materials for the positive and negative electrodes is characterized by the use of perforated metal strip pockets for the negative electrodes containing a powdered zinc active material under pressure to hold the active material in situ and in close elec-

trical contact with the metal strip. By preventing loss of active zinc material during cycling, a greatly extended cycle life is obtained at nearly the initial electrical capacity of the battery. (auth)

8753 Electrodes for storage batteries. Westberg, E.; Andersson, J.; Sundberg, E. (to Aktiebolaget Tudor). US Patent 3,920,479. 18 Nov 1975. Priority date 4 Dec 1972, Sweden. 4p.

A method of fabricating and a sheath for the active material-surrounded conductive rods of a lead—acid storage battery of the liquid electrolyte type is described in which a tubular sheath composed of fibers has short lengths of the end portions mechanically bonded by application of a thermoplastic material in a molten liquid form. 5 figures. (auth)

8754 Alkaline battery seal and protective coating comprising a fatty acidamide. Winger, J. (to Union Carbide Corp.). US Patent 3,922,178. 25 Nov 1975. Filed date 28 Aug 1973. 6p.

A fatty polyamide is employed as a seal or a protective coating in order to prevent alkaline electrolyte from wetting a surface in an alkaline galvanic cell. 4 figures. (auth)

APPLICATIONS

REFER ALSO TO CITATION(S) 8871

8755 (UCRL—77440) **Lithium requirements for electric vehicles using lithium-water-air batteries.** Cooper, J.F.; Borg, I.Y.; O'Connell, L.G. Behrin, E.; Rubin, B.; Wiesner, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Nov 1975. Contract W-7405--Eng-48. 18p. (CONF-760112—2). Dep. NTIS $4.50.

From Symposium on United States lithium resources and requirements by the year 2000; Lakewood, Colorado, United States of America "USA" (22 Jan 1976).

The lithium—water—air battery is a new primary battery of such exceptional power and energy that it is a candidate to provide propulsion for electric automobiles of the future. In the electrochemical reaction involved, lithium, oxygen, and CO_2 are combined; Li_2CO_3 is left as a by-product to be removed from the battery and recycled. A subcompact car weighing 910 kg would transform 7.2 kg of lithium in traveling 320 km at 97 km/hr. At least an equal amount of lithium per car would be unavailable because of the need to recycle the by-product (Li_2CO_3). Thus, a minimum of 14.4 kg of lithium per car is required to support a transportation system based upon this power source. Assuming that, in the year 2000, 12 to 16 percent of all vehicles are powered by lithium—water—air batteries, we will need 234,000 to 425,000 metric tons of lithium. This amount is somewhat less than the total known U.S. lithium reserves; but, if the current rate of consumption of lithium for other purposes continues, the supply of lithium will have to be increased. 4 figures, 5 tables (auth)

ENERGY MANAGEMENT AND CONSERVATION POLICY

REFER ALSO TO CITATION(S) 10048

8756 (BNL—20730) **Perspective on energy accounting.** Beardsworth, E. (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1975. 11p. (CONF-751107—15). Dep. NTIS $3.50.

From 68. annual meeting of American Institute of Chemical Engineering; Los Angeles, California, USA (16 Nov 1975).

This discussion on energy accounting reviews Public Law 935-77, which stipulates that the net energy of a technology be analyzed and considered in evaluating proposals; it doesn't say that net energy is to be used as the only criterion for deciding whether or not to pursue a project, nor that net energy is to be maximized. The author believes that the law should have required an energy accounting instead of a net energy assessment. A most important point is that energy accounting should be viewed as an analysis that is separate, parallel, and complementary to economic and engineering analyses, including environmental and social costs. Energy accounting involves an objective analysis of the physical quantities of energy involved. Prices can change, economic conditions can change, but physical facts do not vary. (MCW)

8757 (ERDA—87-1) **Techniques handbook: project management. Work breakdown structures. ERDA handbook 0805.3 part 1.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Management Information and Telecommunications). 1975. 23p. Dep. NTIS $4.00.

The Work Breakdown Structure (WBS) technique is primarily a project management planning technique which is aimed at defining, within an overall conceptual framework, the detailed products and work effort to be accomplished for successful achievement of the project objective(s). The WBS technique directs the attention of the ERDA project manager, the contractor project manager, and their respective staffs, to insuring that the total project effort is fully planned and that all efforts contribute directly to the project objectives. The technique requires identification of the major end items to be produced by the project effort. By successive subdivision of each end item into increasingly detailed categories and subcategories of product and work, the WBS defines the total project effort in terms of manageable segments (packages) of work which are assignable to a single unit within the performing organization. (from Overview)

8758 (PB—242071) **Glossary of energy terminology.** Erickson, K.; Sherman, D. (eds.). (Virginia Energy Office, Richmond, VA (USA)). 1975. 116p. NTIS $5.25.

This glossary includes abbreviations and definitions of words related to energy, and conversion tables for energy equivalents. (BLM)

8759 (PB—246703) **Energy information in the Federal Government. A directory of energy sources identified by the Interagency Task Force on Energy Information.** (Federal Energy Administration, Washington, D.C. (USA)). 1975. 1038p. (FEA/B—75/375). NTIS.

The Federal Energy Information Locator System (FEILS), which contains information on most of the sources of energy data in the Federal Government, is described and illustrated in this directory. FEILS is the beginning of a comprehensive inventory of existing data sources; eventually FEILS will include all government energy data sources. Using this Directory, Federal agencies collecting specific kinds of energy data can be identified rapidly. The following information on the energy data sources are included in FEILS: the energy source for which data is collected (e.g., coal, natural gas); major functions associated with that energy source (e.g., exploration, reserves, or extraction); more refined characteristics associated with specific energy data sources, such as geographical location, bed thickness of anthracite coal reserves; identification and description of 44 separate Federal agencies, bureaus, and administrations associated with 261 different programs; and program summaries identifying 200 data collection forms, 600 publications, and 98 computerized data bases or major files. The National Energy Information Center of the Federal Energy Administration will have the responsibility of maintaining and enhancing FEILS. An updated Directory will be published annually. (BYB)

8760 ARAB EMBARGO: TWO YEARS LATER. Washington, DC; United States of America (USA); Federal Energy Administration (1975). 27p. (FEA/A—75/607). Office of Communications and Public Affairs, Federal Energy Administration, Washington DC 20461.

The U.S. energy position in 1975 is described, with data presented on: domestic energy supplies and consumption; public attitudes on the energy crisis; and legislative and administrative activity since the Arab oil embargo. Production of coal has increased since 1973, but natural gas and petroleum production has declined. According to a pre-embargo forecast, consumption of petroleum declined by 1.9 million barrels per day in 1974. Electric power consumption decreased slightly in 1974, but increased at a rate of 3% in 1975. The fuel economy of cars has increased significantly with average miles per gallon increasing from 14.4 in 1973 to 17.5 in 1976. Public attitudes show concern about dependence on foregin oil and a recognition of the need to conserve energy. The Congress has enacted 33 energy-related laws since the embargo, including the Emergency Petroleum Allocation Act, the Federal Energy Administration Act, the Energy Supply and Environmental Coordination Act, and the Energy Reorganization Act. Only five of the nineteen legislative and tax proposals in the Presidents energy program have passed both Houses of Congress and are in Conference (Naval Petroleum Reserves, Strategic Reserves, ESECA Extension, Energy Labeling, and Emergency Standby Authority). The Administration's energy actions are also summarized in this report, including its efforts in resource development, conservation, and international relations. (BYB)

8761 Introduction to the ERDA and its plans for the future. Seamans, R.C. Jr. (Energy Research and Development Administration, Washington, DC). *Proc. Am. Power Conf.*; 37: 15-21(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The Energy Research and Development Administration was formed on January 19, 1975, engulfing about 90 percent of the

agencies of the Atomic Energy Commission; all of the Office of Coal Research from the Department of Interior; about 50 percent of the Bureau of Mines; all of the solar and geothermal activities of the National Science Foundation; and a project from the Environmental Protection Agency dealing with advanced automotive propulsion systems. The people and facilities were organized into six areas as specified by law: fossil energy; nuclear energy; solar, geothermal and advanced energy systems; conservation; environment and safety; and national security. An outgrowth of the effort in national security leads to such work as laser isotope separation and laser fusion. The interaction of ERDA with all Federal agencies is explained. Bilateral agreements on energy cooperation exist with 29 foreign countries, as well as a number of international organizations such as Euratom, the International Atomic Energy Agency, and the International Energy Agency. (MCW)

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 8757, 8797, 8798, 8801, 8804, 8805, 8825, 8846, 8857, 8870, 9212

8762 (NP—20695) **Energy research information system. Quarterly report.** Givens, B.; Boyd, C. (Old West Regional Commission, Billings, MT (USA)). Nov 1975. 235p. TIC.

Volume 1, No. 1.

This first Quarterly Report of the Energy Research Information System (ERIS) contains descriptions of 300 current and recently completed energy research projects within the Old West Region (i.e., Montana, North Dakota, South Dakota, Nebraska, and Wyoming) and several projects outside the Region. The purpose of ERIS, a computerized information system, is to provide an inventory of research in the Region and a communication channel for energy research users (e.g., funding agencies, government agencies, industry, and public interest groups). The research projects are categorized under these subject areas: Coal, which is subdivided into general, reclamation, water resource, atmospheric and bioenvironmental studies, social and economic studies, energy conversion and transport, and mining and extraction methodology; Petroleum, Natural Gas, and Oil Shale; Alternate Energy Resources; Nuclear Energy; Other Mined Resources; Energy Conversion/Consumer Aspects; Land Use; and Other. Four indexes are also provided on location, personal name, organization, and subject. (BYB)

8763 (NSF—85-37) **Summary of awards in energy-related general research: fiscal year 1975.** (National Science Foundation, Washington, D.C. (USA)). Jan 1976. 263p. GPO $3.80, Stock No. 038-000-00255-4.

Basic research, rather than specific technological solutions, was funded from a list of 44 phenomena-oriented categories, from Aerosols to Turbulence. One fourth ($26.5 million) of total 1974 energy-related basic research funds was allocated for these grants. Although total funding money in 1975 was less than in 1974, substantial increases in increments covered new investigations. Large increases were made in grants for Homogeneous Catalysis and for Fabrications and Inspection of Materials Forming. Decreases occurred in these areas: Instrumentation, Radiation Effects, Statistics and Probability, Systematic and Evolutionary Biology, and System Theory and Optimization. The ERG (Energy Related General Research) grants are intended to encourage basic research compatible with national priorities. Scientists can respond to project-related goals and still do fundamental work in their specialties. A four page appendix lists energy-related workshops held in 1975. A 237 page appendix lists ERG grants by principal investigator, institution, title, and award in thousands of dollars. (DCK)

8764 (UCRL—50029-75) **Energy and Resource Planning Group annual report for FY 1975.** Werth, G.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jun 1975. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

The report is a coordinated account of the activities of the LLL Energy and Resource Planning Group and the reports that were issued during its first year. The report is divided into three sections. The first section deals with the energy problem in general, with results showing that transportation appears to be the most critical particular aspect of that problem. The second section discusses transportation R and D projects that are appropriate for LLL. The third section reviews responses to requests for studies of energy systems. The LLL work appropriate to the transportation issue involves studies on recovery of oil from oil shale; methanol from in situ processing of coal; the adaptive fuel tank for the introduction of methanol fuel into the gasoline-centered transportation system; an environmental assessment of methanol as an automotive fuel; design of engines optimized for methanol; basic combustion research; and lithium-water-air battery for an electric vehicle. In an appendix, a list of the participants and a bibliography are provided. (MCW)

8765 PROGRAMME FOR FUTURE STUDIES IN SWEDEN. Stockholm; Sweden; Secretariat for Future Studies (1975). 36p. Secretariat for Future Studies, Fack, S-103 10 Stockholm, Sweden.

The Swedish government's program for studies concerning the future is described in this booklet. In May 1971 a Working Party was established to assess the need for future studies in Sweden. This group, composed mainly of scientists, prepared a report entitled, 'To Choose a Future.' As recommended in this report a Secretariat for Future Studies was established on February 1, 1973. Four major projects which have been sponsored by the Secretariat are entitled: 'Energy and Society'; 'Resources and Raw Materials'; 'Sweden in the World Society'; and 'Working Life in the Future.' Brief descriptions of each of these projects are presented. The Energy and Society study examines the relationship of energy to economics, social welfare, environment, societal structure, and foreign policy. A list of publications available from the Secretariat is included. (BYB)

8766 COMPREHENSIVE PLAN FOR ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION. HEARING BEFORE THE COMMITTEE ON SCIENCE AND TECHNOLOGY, U.S. HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION. Congressional Committee Print No. 28. Washington, DC; United States of America (USA); Committee on Science and Technology (1975). 677p.

An oversight hearing was conducted on Public Law 93-577, the Federal Nonnuclear Energy Research and Development Act of 1974. This Act establishes general policy and objectives and provides for Federal funding for nonnunclear research, development, and demonstration (R, D, and D) programs of the Energy Research and Development Administration (ERDA). Administrator of ERDA, Dr. Robert Seamans, Jr., described the plan and program for energy R, D, and D, which are required by Section Six of Public Law 93-577. In reviewing the report presenting ERDA's plan, Dr. Seamans concludes that the U.S. does not have any good energy resource choices; it must continue to import petroleum. ERDA's plan is to aggresively pursue multiple options, with emphasis on those options that can have a major impact. The second witness, Emilio Q. Daddario, Director of the Office of Technology Assessment (OTA), discusses activities of OTA in analyzing ERDA's plans and programs. The Appendix contains the following: ERDA'S report, 'A National Plan for Energy Research, Development and Demonstration: Creating Energy Choices for the Future, Volumes I and II'; 'The Nation's Energy Future,' a report to President Nixon submitted by Dr. Dixy Lee Ray; and three Congressional Research Service Reports. (BYB)

CONSERVATION

REFER ALSO TO CITATION(S) 8386, 8785, 8808, 8809

8767 (BNL—20783) **Perspective on the energy future of the northeast: energy conservation scenarios for the Northeast United States.** Marmor, M. (Brookhaven National Lab., Upton, N.Y. (USA)). Sep 1975. 41p. Dep. NTIS $4.00.

This paper surveys and evaluates measures for energy conservation in the northeast United States for three scenarios--a base case, moderate, and severe conservation scenarios--corresponding to three levels of implementation of each of the conservation measures studied. The Northeast Perspectives Study, of which this paper is a part, will eventually use these three scenarios to determine the extent to which energy conservation can reduce energy demand in the Northeast and thus alleviate pressure on the energy resources available to the region. This paper is limited to the residential, commercial, and transportation sectors. Studies of the industrial sector are currently under way and will be used to establish conservation scenarios. This paper is also limited to a largely technological view of energy conservation for purposes of assessing "what is possible." The next step is to examine the various policy options available to bring about technological changes that are found to be attractive in this analysis. The range of conservation measures that should be considered for application in the northeast is established by first summarizing the literature on energy conservation at the national level. From a survey of the measures considered in these studies, a set of measures for possible implementation in the Northeast is chosen. (auth)

8768 (FEA/D—76/011) **Benefit-cost methodology for evaluating energy conservation programs.** Lind, R.; Nathans, R. (Science Applications, Inc., McLean, Va. (USA)). Dec 1975. 42p. NTIS.

The basic concepts of benefit-cost analysis for conservation are developed and presented for the layman. Specific procedures for computing conservation benefits under different economic conditions are described. In addition, the appendix contains a discussion of this methodology as it applies to two major conservation options, the auto efficiency standard and home insulation. Using existing data, preliminary benefit-cost estimates are developed, and data requirements for improved estimation are discussed. (from Executive Summary)

8769 (NBS-BSS—79) **Energy conservation potential of modular gas-fired boiler systems.** Kelly, G.E.; Didion, D.A. (National Bureau of Standards, Washington, D.C. (USA). Institute for Applied Technology). Dec 1975. 54p. GPO $1.15, SD Catalog No. C13.29:2/79.

The modular concept of boiler operation was examined in a laboratory test of five gas-fired, cast iron, hydronic boilers. Four of the boilers, each having an input rating of 85,000 Btu per hour, were arranged so that they could either be operated like a single boiler (i.e., all of the boilers either on or off) or as a modular installation in which the boilers are sequentially fired to match the number in operation with the heating load. The fifth boiler had an input rating of 300,000 Btu per hour and was operated as a single boiler installation. Efficiency vs. heating load curves were obtained for the single boiler installation, the four small boilers run like a single boiler, and the modular installation operated with and without water flowing through the 'idle' modules. These efficiency curves were then used to theoretically predict the effect of the modular concept and boiler oversizing on the seasonal efficiency of gas-fired heating plants. It was found that under certain conditions the use of a gas-fired modular boiler installation instead of a single large boiler could result in considerable energy savings. (auth)

8770 (PB—244154) **Lighting and thermal operations: energy conservation principles applied to office lighting. Conservation paper No. 18.** (Ross and Baruzzini Inc., St. Louis, MO (USA)). 15 Apr 1975. 288p. (FEA/D—75/404). NTIS $8.75.

A review is presented of the literature and findings upon which the past practice of lighting design has been based. Recommendations and suggestions are made for changes that can be instituted to make lighting design and installation in the future more responsive to the needs of energy conservation and at the same time not compromise the needs of office workers and employers relative to the performance of visual tasks. The report is divided into six sections: Section I is an introduction. Section II provides a summary of conclusions and recommendations covering energy use, human performance visual system design, and management guidelines. Section III, on assessment of energy use for office lighting, reviews the relative magnitude of office lighting energy use and shows the relationship of lighting energy to heating and cooling energy. Section IV deals with illumination of visual performance. Section V is a review of newer techniques and equipment for achieving energy conservation by proper design, and Section VI presents some guidelines and suggestions for energy management. (55 references) (GRA)

8771 (PB—244609) **Carpooling: status and potential.** Kendall, D.C. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center, Office of Systems Research and Analysis). Jun 1975. 121p. (DOT-TSC-OST—75-23). NTIS $5.25.

Studies were conducted to analyze the status and potential of work-trip carpooling as a means of achieving more efficient use of the automobile. Current and estimated maximum potential levels of carpooling are presented together with analyses revealing characteristics of carpool trips, incentives, impacts of increased carpooling and issues related to carpool matching services. National survey results indicate the average auto occupancy for urban work-trip is 1.2 passengers per auto. This value, and average carpool occupancy of 2.5, have been relatively stable over the last five years. An increase in work-trip occupancy from 1.2 to 1.8 would require a 100% increase in the number of carpoolers. A model was developed to predict the maximum potential level of carpooling in an urban area. Results from applying the model to the Boston region were extrapolated to estimate a maximum nationwide potential between 47 and 71% of peak period auto commuters. Maximum benefits of increased carpooling include up to 10% savings in auto fuel consumption. A technique was developed for estimating the number of participants required in a carpool matching service to achieve a chosen level of matching among respondents, providing insight into tradeoffs between employer and regional or centralized matching services. Issues recommended for future study include incentive policies and their impacts on other modes, and the evaluation of new and ongoing carpool matching services. (11 references) (GRA)

8772 (PB—246352) **Effects of price on energy conservation.** (Federal Energy Administration, Washington, D.C. (USA)). 18 Aug 1975. 10p. (FEA/D—75/663). NTIS $3.50.

Although most conservation programs are not yet in effect, energy consumption in the last two years has declined where prices have risen substantially. Consumption has continued to increase in the mountain states where price increases have been smaller. Plotting the relationship of price with demand and the actual consumption of energy in relation to weather, the recession, and price shows that price can account for the major part of the 11% reduction. Comparisons with other countries, economic research, and opinion surveys, while they disagree on the point at which price becomes decisive, bear out this conclusion. Voluntary conservation efforts emphasize efficiency and substitution. Federal initiatives will stress higher standards, tax credits, and increased public awareness. (DCK)

8773 INDUSTRIAL ENERGY CONSERVATION REPORT. FACT SHEET, REVISED. Washington, DC; United States of America (USA); Federal Energy Administration (1975). 16p. Office of Communications and Public Affairs, Federal Energy Administration, Washington, DC 20461.

According to this 1975 Fact Sheet, steady progress is being made in energy conservation and efficiency improvement in 10 energy-intensive industries of the U.S. Most conservation measures that result in immediate benefits have been implemented. Energy use data are presented for the following industries: aluminum, petroleum refining, chemicals, steel, cement, paper, glass, baking, meat packing, and copper. The conservation activities of these industries are being reported voluntarily as a part of the Industrial Energy Conservation Program sponsored by the Federal Energy Administration and the Department of Commerce. Accomplishments of these industrial groups are summarized in tabular form, and progress that individual industries have made in energy conservation is described. (BYB)

8774 ENERGY HANDBOOK FOR SMALL BUSINESSES: HANDLING FUEL AND FUEL PROBLEMS. Report No. FEA-005-A. Washington, DC; United States of America (USA); Federal Energy Administration (1975). 16p. GPO $0.35, Stock No. 041-018-00072-1.

Government programs which aid small commercial enterprises in securing adequate fuel supplies are explained in this handbook. Sections are included on: 1) how to get more fuel; 2) emergency fuel problems; 3) which small businesses are top priority for fuel distribution; 4) price questions; and 5) policies on hoarding fuel. This handbook also suggests energy conservation procedures appropriate for factories and office management. Examples of actual savings achieved by commercial offices and plants are described, and an energy conservation checklist is provided. (BYB)

SYSTEMS STUDIES AND TOTAL ENERGY

REFER ALSO TO CITATION(S) 8791

8775 (BNL—20426) **User's guide for regional reference energy systems.** Bronheim, H.; Nathans, R.; Palmedo, P.F. (Brookhaven National Lab., Upton, N.Y. (USA); State Univ. of New York, Stony Brook (USA)). Nov 1975. 96p. Dep. NTIS $5.45.

The report is a user's guide to an analytical approach to energy planning originally developed for national analysis, but now adaptable to regional and state planning. A number of reports are available that summarize the development and use of the regional energy planning methodology. This report describes the structure of the model and how it is used (in Chapter II) and indicates where data are available and how they can be assembled into the analytical framework (Chapter III). In Chapter III, the various sections of the model--energy demands, electricity demand, fossil fuel supply--are described and the means to construct them are layed out in the user assembly forms of Appendix A. A submodel for estimating residential energy consumption and commercial heating and air conditioning load calculation are data supplied in Appendices B and C. The version of the methodology presented here does not depend on the use of computers. A computerized version of the methodology is available and is convenient both from the point of view of data storage and manipulation and from the point of view of policy analysis. (MCW)

8776 (CAC/TM—49) **Technical coefficients for inputs to new energy technologies.** Swift, M.A. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Apr 1975. 24p. NTIS.

The derivation of input-output technical coefficients is described for inputs to four new energy supply and conversion technologies from non-energy technologies for use in the modified

'energy products' energy/employment policy model at the University of Illinois Center for Advanced Computation. The four new technologies are solvent-refining of coal, oil shale mining and retorting, high temperature gas-cooled reactor electricity generation, and COGAS combined cycle electricity generation. The coefficients are given in units of dollars per billion Btu and represent the inputs from nonenergy sectors (e.g. manufacturing, transportation, services) required per unit of production by one of the energy supply technologies. The 85 non-energy sectors included are based on the Bureau of Economic Analysis 83 sector input-output structure with minor disaggregations. The paper also presents the input-output coefficients for inputs from energy sectors to these four new technologies as well as to one additional technology: coal gasification. (auth)

8777 (COO—2547-4) **Considerations for a regional energy - environment game.** Denton, J.; Saaty, T.; Blair, P.; Ma, F.; Ojalvo, S.; Rahbar, F.; Shimamoto, G. (Pennsylvania Univ., Philadelphia (USA)). 30 Jun 1975. Contract E(11-1)-2547. 148p. Dep. NTIS $6.00.

The elements and structure of a small-scale regional energy-environment game are presented, with special emphasis on the definition of appropriate actors and state variables as well as characterization of the target region for which the game is designed. The results of this Phase I game will be used to aid the design of components in a more comprehensive game (Phase II) that can be used for investigating various energy-environment scenarios in a regional assessment study program. The principal results that will be used in the Phase II effort are: (1) definition of the target region; (2) development of reference scenarios describing energy-environment trends and mechanisms within the target region; (3) characterization of principal actors involved in the regional energy - environment system; and (4) definition of a set of factors or state variables that reflect the state of that system. (auth)

8778 (ERDA—107(Vol.1)) **Program for regional energy analysis. Final report.** Benson, W.R. (Midwest Research Inst., Kansas City, Mo. (USA)). Dec 1975. Contract AT(49-1)-3755. 141p. Dep. NTIS $5.45.

This study resulted in the development of a systematic method for the study of energy systems on a subnational level, including identification of criteria relevant to the evaluation of competing energy supply systems. A program of action was designed for the participation of local, state, or regional organizations with crucial roles in energy policy and energy R and D. The Regional Energy Analysis Program (REAP) was designed, and it provides a uniform procedure for analysis of the regional impacts and the consequences of policy decisions relative to R and D leading to new energy sources. It is also applicable to the analysis of the impacts of significant expansion of existing supply sources. Five tasks that formed the basis for the program design were: definition of regions, identification of data sources, inventory of models, public participation strategy, and development of candidate programs. As the regional energy analysis program evolved, elements of the program were selectively tested or validated using data from a new energy production technology. An oil shale plant and a solar thermal electric power plant were used in the tests because of the availability of data. (MCW)

8779 (ERDA—107(Vol.2)) **Program for regional energy analysis: appendices to the final report.** (Midwest Research Inst., Kansas City, Mo. (USA)). Nov 1975. Contract AT(49-1)-3755. 293p. Dep. NTIS $7.60.

Appendix A is a Data Sources Handbook to serve as an important portion of the methodology used to prepare the Impact Analysis report for the Regional Energy Assessment Program (REAP). Appendix B, a Models Handbook, identifies and evaluates existing models that may have application to predicting the impacts of energy-related R and D at the regional level. A tabulation of 147 models is made with its organization identified. A separate listing of available watershed models is given. Appendix C, Organizations Handbook, discusses the six currently adapted versions of review and participation procedures: mail review, "Blue Ribbon" panel reviews, ERDA hearings, political review, clearinghouse review, and national review committee procedures. In Appendix D, A Generalized Cost Model to Estimate Regional Energy Prices with Sample Application, a computer program BTU-COST is used to estimate the unit price for energy produced by solar electric power plants and oil shale plants. Then, the following two appendices summarize the oil shale and solar thermal technologies. (MCW)

8780 (HUD-PDR-EIS—75-1F) **Application of modular integrated utility systems technology. Final environmental statement.** (Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research). Oct 1975. 240p. NTIS.

The environmental impact associated with installing and operating Modular Integrated Utility Systems (MIUS) is assessed. The MIUS combines several utility services, including electric power, heating and cooling, potable water, fire protection water, liquid waste treatment, and solid waste management for a community. Local consequences were examined as were the effects of the use of alternative MIUS components, subsystems, and processes. The results of analyzing a single hypothetical MIUS application were extended to evaluate nation-wide use of the MIUS concept within constraints of the market projections. In comparison to conventional utility systems, MIUS conserves fuel energy; however, with present technology, MIUS would consume gas or oil, both of which are in limited supply. The impacts of MIUS construction on air and water quality, traffic, land use, community services, and aesthetics would be only slightly greater than the total impact of constructing a large housing development. MIUS operation would result in a ground level air pollutant concentration amounting to only a small percentage of those acceptable by the Primary Federal Air Quality Standards. Impacts on surface water quality and aquatic biota from the MIUS liquid waste treatment system are expected to be small. The potential for adverse effects on aquatic biota is essentially identical for both MIUS and conventional sewage treatment systems; however, it is larger for conventional electric plants than for MIUS. MIUS and conventional utility alternatives use approximately the same amount of land, but the MIUS consumes and withdraws less water. (143 references) (BYB)

8781 (ORNL-HUD-MIUS—15) **MIUS technology evaluation: comparison of trenching costs for separate and common trenching.** Meador, J.T. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 71p. Dep. NTIS $6.00.

Estimates are made of the combined costs associated with excavating, backfilling, and compacting several classes of soil in trenches required for the installation of utilities. Earthwork costs include estimates for both that earthmoving equipment and operating-labor requirements. Published cost rates are applied to appropriate sections of trenches in order to estimate total earthwork costs. Trench cross sections used comply with Occupational Safety and Health Administration (OSHA) standards. The derived trenching cost data are then used for estimating the possibility of cost reduction through the application of "common trenching" methods to several configurations of one section of mains that are of sufficient size to meet the demands of a large garden-apartment complex served by a Modular Integrated Utility System (MIUS). The results show that earthwork costs could be reduced by about one-third by using a common trench with moderately compact spacing between utilities rather than by providing separate trenches for each type of utility. However, close spacing would lead to limited accessibility for maintenance, and the additional cost resulting from limited accessibility is not estimated in this study. Potential savings were small or negligible in installations that have large spacing between utility service mains thus providing ready accessibility for maintenance. (auth)

8782 (ORNL-HUD-MIUS—19) **MIUS technology evaluation: compression refrigeration systems for air conditioning.** Claffey, C.J.; Segaser, C.L. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 46p. Dep. NTIS $5.50.

The technology of compression refrigeration for air-conditioning systems is well established. Its widespread application in warmer climates throughout the world attests to its general acceptance as a reliable means of providing comfort air conditioning. Currently, a diverse selection of air-conditioning equipment is available to suit any air-conditioning application. With the exception of some of the room air conditioners, compression machines produce the desired cooling effect in an efficient manner. Some of the small-capacity machines, however, are notably efficient, thus proving that a relatively high efficiency is attainable even in the smaller machines. This evaluation describes the current status (as of May 1973), performance, and costs of the types of compression refrigeration equipment considered suitable for use in MIUS to provide residential space cooling. The following topics are discussed in this report: (1) the fundamental refrigeration cycle; (2) a variety of types of mechanical refrigeration compressors; (3) selection of refrigerant fluid; (4) efficiencies of different systems; (4) performance values applicable to different systems; (5) energy flow, and (6) capital, operating, and maintenance costs. In addition, a listing of manufacturers of compression-type air-conditioning equipment and their products is provided. Final selection of component size and type depends on the design of the MIUS installation in which the refrigeration system would be included and on the cooling requirements of the community to be served.Life-cycle cost analyses, which should be a major factor in the selection of any of the MIUS subsystems, require systems analyses based on the particular MIUS design, the community to be served, and other site-specific characteristics. Such systems and life-cycle cost analyses are outside the scope of this report. (auth)

8783 MATHEMATICS FOR ENERGY. Snow, D.R. Philadelphia; United States of America (USA); SIAM Institute for Mathematics and Society (1975). 17p. SIAM Institute for Mathematics and Society, 33 S. 17th St., Philadelphia, PA 19103.

A summary report of the Research Application Conference held at Alta, UT, July 7-11, 1975.

During this conference 35 mathematicians, economists, engineers, business leaders, and others met to discuss mathematics and mathematical modeling related to energy problems. This paper serves as a summary of the mathematical problems discussed at the conference. Twenty-nine fields of mathematics used in energy associated problems are listed. Discussion centered on a few of these fields, including optimization, programming, systems theory, game theory, and calculus of variations and control theory. A needs assessment of research on modeling resulted in 10 suggestions for studies, including energy supply and demand models, optimal depletion of resources, simulations of energy technologies, and models of transmission and transportation of energy. The conference goal was to help mathematicians and model builders understand each other's problems. An on-going bibliography of mathematics related to energy research was recommended, with the report listing 43 references as a start. Better communication with government and the public will help both groups. (DCK)

8784 Simulation of energy flow and land use: SPECULATER 1975. Brewer, J.W.; Watt, K.E.F.; Young, J.W.; Mitchiner, J.L.; Ayers, C.; Hunter, Y.L. *Simulation;* **26**: No. 2, 157-160(Simulation Today, No. 40)(Feb 1976).

An update is given of a simulation model (previously presented, see EAPA 1:01013) of the interaction of national urban, agricultural, and energy-use systems. New empirical evidence is provided to substantiate the hypothesized interactions. The results of simulations of the new version of the model are presented and the implications for public policy are explained. (auth)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 8789, 8802, 8821, 8827, 8832, 8836, 8856

8785 (BNWL-SA—5622) **Energy problems and potential solutions.** Schmid, L.C. (Battelle Pacific Northwest. Labs., Richland, Wash. (USA)). 16 Oct 1975. Contract E(45-1)-1830. 13p. Dep. NTIS $3.50.

The background and current status of the energy situation, energy supplies relative to demand, and potential solutions to the problems faced by the USA and by individuals in the USA are discussed. The USA followed an energy scenario demanding more and more oil and natural gas resulting in its reserves of oil and natural gas becoming scarce. The past and future trends in energy use show a greater growth rate for oil and gas relative to other resources, and reserves of these resources are not being found as rapidly as they are being removed from the ground, resulting in greater independence on imported Eastern oil. This has resulted in a trade imbalance. Electricity is a major growth area, its generation now dependent on coal and nuclear fuels when formerly dependence had been on oil and gas. These factors are resulting in some current shortages of energy, especially electrical power and natural gas; increasing energy costs; a growing dependence on foreign supplies of fuel; and increased consideration of the social and environmental aspects of energy production, as well as technical and economic ones. In the short and intermediate term, logical solutions based on the energy scenario are to reduce energy demand through conservation; to move away from using scarce resources such as oil and gas which now provide approximately 78% of U.S. energy; to move toward the use of moreabundant resources such as coal and uranium; and to develop domestic supplies of oil and gas. In the longer term, renewable sources such as solar, fusion, and geothermal need be developed. Currently, hydropower, natural gas, oil, nuclear, uranium, geothermal, solar, and fusion are expected to fill in as sources of energy to meet the needs after conservation. (MCW)

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 8768, 8772, 8784, 8810, 8813, 8820, 8821, 8826, 8833, 8836, 8851, 8852, 8853, 8854, 8855, 8858, 8860, 8869, 8872

8786 (CAC/TM—60) **U.S. energy balance of trade: 1963-1973.** Herendeen, R.A.; Bullard, C.W. III. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1975. 13p. NTIS.

The import and export of goods and services for the U.S. in 1963, 1967, and 1973 are energy-costed. Despite the fact that net imports of fuels increased drastically, the energy embodied in imported goods changed very little (averaging about 6% of domestic production), and imports and exports of goods remained in nearly complete energy balance. (13 references) (auth)

8787 (FEA/B—75/376) **Report to Congress on the economic impact of energy actions, as required by Public Law 93-275, Section 18(D).** (Federal Energy Administration, Washington, D.C. (USA)). Jul 1975. 123p. NTIS.

An assessment is made of the economic impact of the energy situation for the 6-month period starting with the fourth quarter of 1974 and ending with the first quarter of 1975. Significant findings include the following: U.S. consumption of energy declined for the first time in 20 years; employment in energy producing sectors increased; the severe impact of energy prices on the rate of inflation abated toward the end of 1974 and in early 1975; natural gas curtailment resulted in lost production and increased cost in some industries; after a deficit of over $5 billion in 1974, the U.S. merchandise trade balance showed a surplus of $1.8 billion in the first quarter of 1975. (auth)

8788 (NP—20645) **Conference on the political economy of depletable resources.** (Maryland Univ., College Park (USA)). 1975. 52p. TIC.

Summary report of a conference held at Brookings Institution, Washington, DC, June 9 and 10, 1975.

Basic economic and political science research applicable to current energy-related policy questions was discussed at this conference. Session 1, which dealt with public choice and resource use, identified the need for research on the role of institutions as they grow and respond to economic and political forces. Session 2, on cartels and coalitions of countries and corporations, pinpointed the need for research on: (1) the theory of cartel formation and behavior; (2) development of models to test political and economic trade-offs; (3) the implications of cartel models in the theory of conventional international trade; (4) a study of the short and long term effects of OPEC on international economic order; and (5) a review of the effect of cartels on third world countries. Session 3, on the political economy of shortages, focused on government interference in the market and recommended a study to limit the power of legislators. An appendix contains some of the prepared remarks of participants. (DCK)

8789 (PB—246271) **Economic impact of energy shortages on commercial air transportation and aviation manufacture. Volume 1. Impact analysis.** Gorham, J.E.; Gross, D.; Snipes, J.C. (Stanford Research Inst., Arlington, VA (USA)). Jun 1975. 265p. (FEA/B—75/588). NTIS $8.50.

The economic impact of energy shortages on commercial air transportation and aviation manufacture is assessed in this study. Volume I presents: 1) the impact analysis of energy scarcity on the air transportation industry; and 2) the summary and conclusions of the entire report. Both near-term and long-term effects of energy shortages are investigated. The forces of change at work in the industry are appraised, and the impact that energy shortages and fuel prices have on these forces is evaluated. The current and future prospects of commercial aviation are analyzed under Project Independence Blueprint scenarios. (BYB)

8790 (PB—246272) **Economic impact of energy shortages on commercial air transportation and aviation manufacture. Volume 2. Aviation industries profiles and energy usage characteristics.** Gorham, J.E.; Gross, D.; Snipes, J.C. (Stanford Research Institute, Arlington, Va. (USA)). Jun 1975. 282p. (FEA/B—75/589). NTIS $8.75.

The purpose of this study was to determine the economic impact of energy scarcity on the air transportation industry. Volume II provides a data base on the characteristics and operating performances of the air transportation industry and the aircraft, engines, and parts manufacturing industries, including energy usage characteristics and efficiency. (BYB)

8791 Preparing an economic analysis of an on-site energy system. Meckler, M. (Energy Group, Los Angeles). *Consult. Eng. (St. Joseph, Mich.);* **46**: No. 2, 45-47(Feb 1976).

The economic goals of an energy system maximize benefits and minimize resources committed or consumed. Complex value judgements and trade-offs must be made. A formula useful for determining energy cost savings for various options using on-site electric generation and prime mover heat recovery versus purchased electricity and fired boilers is given and discussed. The first step in a complete analysis is to compile a list of annual cash flows for every year of the projected life of the particular system.

The next step is to determine net present value of costs, net present value of savings, or uniform annual cost. The economic life and the discount rate vary according to conditions. The primary goal of an energy supply system economic evaluation is to determine which type of system presents the minimum use of resources or the lowest cost. Minimizing overall energy consumption may take precedence over immediate economic objectives. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 8763, 8765, 8766, 8767, 8774, 8788, 8816, 8823, 8826, 8829, 8830, 8833, 8838, 8846, 8849, 8851, 8852, 8853, 8854, 8858, 8863

8792 (AED-CONF—75-305-000) **Summaries of the lectures held on the occasion of the meeting of the 'Energiewirtschaftliches Institut and der Universitaet Koeln'.** (Koeln Univ. (F.R. Germany). Energiewirtschaftliches Inst.). 1975. 8p. (In German). INIS.

From International working conference on the new orientation of the energy market; Koeln, F.R. Germany (17 Apr 1975).

Available from ZAED.

The lectures relate to the following issues: (1) the new situation on the world energy market and its effects on international economy; (2) tasks and ways of international cooperation in the energy sector; (3) the relation between goals envisaged by the state and individual economic decisions; (4) energy research as a field of national and international cooperation; (5) the demands made on capital market and tax legislation by investment financing of the power economy; (6) problems of a medium- and long-term energy policy; and (7) corporate strategy for energy corporations in a structurally changing environment. (DE)

8793 (CONF-751080—) **Complete proceedings of the mid-Appalachia energy symposium held at the University of Tennessee, Knoxville, October 6, 1975.** (Tennessee Univ., Knoxville (USA)). 7 Oct 1975. 165p. Dep. NTIS $4.50.

From Mid-Appalachia energy symposium; Knoxville, Tennessee, USA (6 Oct 1975).

Dr. John Gibbons, Director of the University of Tennessee Environment Center, served as symposium chairman. Federal officials outlined the Federal energy program and its policies at the Federal level in the first segment of the symposium. Dr. Robert Fri, Deputy Administrator of ERDA, spoke mainly on energy choices for the future. Roger Sant and John Quarles of FEA, who are responsible for developing strategies to ensure that energy is used efficiently and that environmental quality goals as well as energy goals are achieved, also spoke on Federal programs and perspectives. Mr. Don Whitehead, Federal Co-chairman of the Appalachian Regional Commission, was the moderator of a panel discussion whose members are living in Appalachia. John Bolinger, President of the Tennessee Natural Gas Company; John Moore, chairman of the Economics Department of the University of Tennessee; and James F. Watson, Manager of Power, TVA, were the spokesmen on the panel. Frank Zarb, FEA Administrator, charged with integrating energy programs and policies, summed up the proceedings briefly, as follows: in the 1960s, the U.S. sold out to cheap oil far from its shores; then began an economy based on cheap oil, leaving the development of alternative energy sources unattended until 1973 when the cheap oil price advanced $2 billion a year. Mr Zarb then analyzed the effects of paying for the imported oil on the American employment situation; if the money had been invested in developing American energy and keeping American factories going, many Americans would still be employed. (MCW)

8794 (NP—20652) **Remarks prepared for delivery by the Honorable Frank G. Zarb, Administrator, the Federal Energy Administration, before the Royal Institute of International Affairs, Chatham House, London, England, December 1, 1975.** (Federal Energy Administration, Washington, D.C. (USA)). 1975. 8p. TIC.

Published in the Federal Energy News.

An effective International Energy Agency (IEA) must be based on mutual understanding of the similarities and differences of the consumer nations. Countries that import energy resources need to develop the same solidarity that the Organization of Petroleum Exporting Countries (OPEC) has given the producing nations. While all the consumer nations share problems stemming from prices and fear of production and supply cutbacks, there are several important differences: (1) a range in energy resource endowment, with the U.S. and Japan at opposite extremes; (2) a range in conservation attitudes and priorities; and (3) variations in foreign policy and relations with Middle East countries. U.S. participation in IEA should include developing its own effective national energy policy and providing leadership in international programs. This will require a commitment to stabilize domestic policies of pricing and develop a capability for strategic petroleum storage. (DCK)

8795 (NP—20657) **Kentucky's response: research and development to meet the Nation's energy needs.** (Kentucky Center for Energy Research, Lexington (USA)). 1975. 49p. TIC.

The dimensions of the energy dilemma are reviewed, and past and ongoing Kentucky efforts to provide additional domestic fuels are discussed. Since Kentucky is the leading coal-producing state in the U.S., much of the energy efforts in this state are aimed at coal production. The expansion of Kentucky's energy resource utilization program, funded by a $57.7 million appropriation in 1974, is discussed in detail. Kentucky's Project Independence is summarized in the appendix. (BLM)

8796 (NP—20696) **Nonnuclear energy scenarios.** Bates, D.M. (Library of Congress, Washington, DC (USA). Congressional Research Service). 6 Jun 1975. 46p. TIC.

The legislative history of the Energy Research and Development Administration's (ERDA) responsibilities under the Federal Nonnuclear Energy Research and Development Act of 1974 (P.L. 93-577) is reviewed. In particular, the legislative history of the requirements that ERDA formulate comprehensive energy plans and programs for short-, medium-, and long-term is examined. A discussion of the Energy Reorganization Act of 1974 points out why additional legislation was thought necessary. The legislative history of the P.L. 93-577 is summarized, with an analysis included of those sections of the Act which relate to the formulation of a comprehensive Federal plan and program. Finally, the progress of the comprehensive plan and program for energy research, development, and demonstration is traced through the Senate, the House, and the conference committee. The Appendix is a brief section-by-section summary of P.L. 93-577. (BYB)

8797 (NP—20697) **Federal interagency coordination of nonnuclear energy research and development.** Bates, D.M. (Library of Congress, Washington, D.C. (USA). Congressional Research Service). 6 Jun 1975. 27p. TIC.

Coordination between agencies involved in nonnuclear energy R and D is studied by looking at the legal requirements for interagency relationships in related legislation, and by examining the Energy Research and Development Administration's (ERDA) implementation of its coordinating responsibilities. The energy R and D legislation of the 93rd Congress emphasizes collaborative efforts between ERDA and other Federal and non-Federal departments, agencies, and groups. The legal stipulations for interagency cooperation are discussed as stated in the following laws: the Energy Reorganization Act of 1974; Federal Nonnuclear Energy Research and Development Act of 1974; the Solar Heating and Cooling Act of 1974; Geothermal (P.L. 93-410) and Solar Energy (P.L. 93-473) Research, Development and Demonstration Acts of 1974; and the National Science Foundation Authorization Act, 1976. These requirements range from mandatory requirements to permissive authority. Information is provided on actions that have been taken by ERDA to implement these legal requirements for coordination in energy R and D. (BYB)

8798 (NP—20699) **Federal organization for nonnuclear energy research and development activities of departments and agencies other than ERDA: FY 1976.** Bates, D.M. (Library of Congress, Washington, DC (USA). Congressional Research Service). 30 May 1975. 90p. TIC.

Revised Aug 1975.

The purpose of this report is to summarize the activities of Federal departments and agencies, other than the Energy Research and Development Agency (ERDA), in energy R and D. Approximately $2.115 billion will be spent in fiscal year 1976 for Federal energy R and D by these departments and agencies: ERDA; Nuclear Regulatory Commission (NRC); Environmental Protection Agency; Department of the Interior; National Science Foundation; Departments of Transportation, Defense, Agriculture, and Commerce; and the National Aeronautics and Space Administration. The R and D efforts will be directed toward five program areas: fossil energy (coal, oil, gas, and shale), solar and geothermal, conservation, nuclear energy, and environmental control. Research support programs of the energy R and D programs will fund basic research and studies of environmental effects. Information, provided for each department and agency except ERDA, includes an identification of the units with principal energy R and D responsibilities, anticipated energy R and D funding, and program area details. Because the emphasis of this report is on non-nuclear energy, the NRC is covered briefly. Although the Federal Energy Administration is not listed as an agency with a direct energy R and D program, information is presented on its R and D program. (BYB)

8799 (PB—245021) **Energy emergency plan for Connecticut.** (Connecticut Energy Agency, Hartford, Conn. (USA)). 15 Jan 1975. 346p. NTIS $8.50.

This Plan provides a framework which allows the State of Connecticut to respond firmly, quickly, and equitably to an energy emergency. The Plan furnishes the Governor with a range of measures aimed at curtailing demand in the short-term that can be implemented on a voluntary basis. The Plan discusses the national energy dilemma as it affects Connecticut by examining Connecticut's energy resources including petroleum products, natural gas, coal, and electricity in terms of demand, distribution, supply security and logistics, and emergency planning. Potential energy savings for the various contingency measures are enumerated, and a profile of each vis-a-vis economic impact, basic life support impact, and public safety/services impact is given. A shortage index, designed to insure a match between the response measure and fuel supply problem is defined and explained. Exhibits are included. (GRA)

8800 (UIUC-CAC-DN—116) **Energy and the regional planner.** Bullard, C.W. III. (Illinois Univ., Urbana (USA). Center for Advanced Computation). May 1974. 14p. NTIS.

From 40th Annual National Planning Conference: The Politics of the New Scarcities; Chicago, IL (May 1974).

A land use planner can substantially affect energy demand in many ways. The planner designs the constraints within which the residents of an area choose to adopt energy conserving or energy wasteful lifestyles. This paper defines the energy impact of planners' decisions, and develops a way of thinking about energy, so it can be considered at every stage of the comprehensive planning process. Suggestions are offered for designing features into a community to insulate it from the instabilities of energy shortages and expected price increases. (auth)

8801 ANALYSIS OF THE ERDA PLAN AND PROGRAM. Washington, DC; United States of America (USA); Office of Technology Assessment (1975). 318p. (NP—20806). GPO $3.85.

An analysis is presented of the program plan submitted by the Energy Research and Development Administration (ERDA) to Congress on June 30, 1975, entitled "A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future." Included in this analysis are background data and discussions of the major issues and questions, to enable Congress to review ERDA's energy R and D programs. It is stated that the ERDA Plan (Volume I of ERDA's report) is a "significant milestone in the evolution of a long-term national energy policy," but that "the ERDA Program (Volume II), to implement this plan, does not appear adequate to achieve the stated goals." Two major deficiencies in the program are pointed out: (1) ERDA's emphasis on technological research with little consideration for the research needed to overcome non-technical constraints to using new technologies; and (2) insufficient emphasis on energy conservation. (BYB)

8802 ENERGY SUPPLY PLANNING MODEL. VOLUME I. MODEL STRUCTURE AND USE. VOLUME II. USER'S MANUAL AND APPENDICES. Carasso, M.; Gallagher, J.M.; Sharma, K.J.; Gayle, J.R.; Barany, R. San Francisco; United States of America (USA); Bechtel Corporation (1975). 527p.

Final Report to the National Science Foundation, Office of Energy R and D Policy.

The model described in this report was developed to assess the feasibility of proposed energy supply policies according to the time, capital, manpower, materials, and construction needed for each energy supply system. This Energy Supply Planning Model can convert future (1975 to 1995) energy supply mixes to resource requirements schedules. The report explains the purpose of the model, the purpose and scope of the data base, and the methodology employed. Also, the model is applied to the analysis of a current energy program proposal and several alternative energy scenarios. In Volume I the study is documented with a description of the structure and function of the model and an illustration of its use. Volume II provides instructions for the use of the computer model and more detailed information than Volume I, including computer printouts of model runs. (BYB)

8803 DEPARTMENT OF THE INTERIOR AND RELATED AGENCIES APPROPRIATIONS FOR 1976. HEARINGS BEFORE A SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS, HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION. PART 8. Washington, DC; United States of America (USA); Committee on Appropriations (1975). 772p.

The following hearings were held: National Park Service--Mining in the parks; National Park Service--Concessions Management; Bureau of Indian Affairs/Navajo and Hopi Relocation Commission (Budget Amendment); Geological Survey--Onshore lease management, to discuss studies of management practices; Energy Research and Development Administration--Budget Amendment request to reflect an analysis of national priorities for balancing energy R and D programs; Federal Energy Administration--Budget Amendment requesting supplemental appropriations for 1,483 positions and $147.6 billion needed because assumptions of regulatory control and conservation programs led to underestimated needs; Outer Continental Shelf Leasing, to consider results of modifications in the leasing program due to concern for state involvement in leasing procedures; and Bureau of Mines--Budget Amendment for supplemental appropriations to allow expansion of Bureau of Mines coal mining effort, with research on extraction procedures for thick seams and environmentally acceptable techniques for stripping. (DCK)

8804 AUTHORIZING APPROPRIATIONS FOR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION. CONFERENCE REPORT TO ACCOMPANY H.R. 3474. Congressional Committee Print No. 94-514 (Senate), 94-696 (House of Representatives). Washington, DC; United States of America (USA); Congressional Committee of Conference (1975). 83p.

Compromise by the House and Senate Conference Committee (chaired by Sen. Henry Jackson) was needed to bring the ERDA budget in line with information and program developments subsequent to original requests. Decisions to accelerate nonnuclear programs led to the following changes: authorization for increases in solar, fossil, and geothermal programs, and conservation R and D; authorization for increments only for physical research, environment and safety, and program support; and no changes in advanced energy systems supporting activities, scientific and technical education, or programs conducted by the Council on Environmental Quality, Water Resources Council, or National Bureau of Standards. Major additions are in Section 102, to establish an oil shale demonstration program and in Section 103, to provide up to $6 billion in loan guarantees for construction of commercial demonstration facilities. Increases in nuclear programs are: (1) $99.5 million for increased electrical costs at gaseous diffusion plants; (2) $1.9 million for safeguards; and (3) $91.9 million for expanded research, particularly nuclear fuel cycle and light water reactor technology. (DCK)

8805 ELECTRIC VEHICLE RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1975. HEARINGS BEFORE THE SUBCOMMITTEE ON ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY, U.S. HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION ON H.R. 5470. Congressional Committee Print No. 27. Washington, DC; United States of America (USA); Committee on Science and Technology (1975). 1144p.

The Demonstration Act would set up within ERDA a program to address all aspects of electric vehicle transportation through a three-year research, development, and demonstration project. The hearings included input from the public, the executive branch, and the private sector, including the electric vehicle and the automotive industry--from the smallest interested concern to the largest. Four key issues were the obvious differences in Government and industry opinion regarding the ready availability of reasonably competitive technology, the timing of the demonstration, the best means to include both large and small businesses while protecting small businesses, and the type of support the Government should provide. The feasibility of a hybrid electric-internal combustion vehicle was explored. The near-term demonstration features of the bill, which calls for demonstration within one year of 5000 vehicles on conventional chassis, using current type lead-acid batteries, are questioned. Most witnesses approved of Federal assistance in R and D for improved battery technology and encouragement of smaller independent manufacturers. Many key technical and socio-economic problems relating to the development and commercialization of electric vehicles are pinpointed in the testimony. (BLM)

8806 Effect of environmental legislation on fuels availability for electric power generation. Gakner, A.; Feusch, C.F.; Dotter, J.; Stewart, H. (Federal Power Commission, Washington, DC). *Proc. Am. Power Conf.*; 37: 289-294(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The Clean Air Act of 1971 established national ambient air quality standards to be implemented by the states with the expectation that by the middle of 1975 emissions could be reduced. Many State Implementation Plans included sulfur oxide emission standards that were more strict than necessary to meet or to maintain health-related ambient air quality standards. The embargo by OPEC has resulted in a national policy of limiting oil imports whenever possible, but at the same time domestic output of natural

gas is not meeting the growing demand and its supply to electric power plants is being curtailed. In addition, the recession has forced extensive delays in nuclear power plant construction. Emissions have increased less rapidly; more low-sulfur coal and much more low-sulfur oil have become available to utilities. The development of commercial scrubbers appears imminent, but solutions to environmental problems are being deterred by inflation and recession. The authors believe that the investment necessary for the scrubbers is unrealistic and leads to the conclusion that existing laws must be revised to provide, at least temporarily, for compromise solutions. One such viable solution is a more liberal acceptance of Intermittent Control Strategies until such time that much more low-sulfur coal becomes available and scrubber technology has been substantially improved. (MCW)

8807 Policy of options. Fri, R.W. (Energy Research and Development Administration, Washington, DC). *J. Air Pollut. Control Assoc.*; **25**: No. 9, 912-914(Sep 1975).

Certain aspects of ERDA policy, especially as relates to potential environmental effects, are presented in this address to the annual meeting of the Air Pollution Control Association. The need to research and develop energy options is stressed. Cooperation between environmentalists and ERDA is urged and welcomed. (JWP)

8808 Energy efficiency standards: voluntary or mandatory. Sant, R.W. (Federal Energy Administration, Washington, DC). *Conference Board Record;* **12**: No. 12, 49-51(Dec 1975).

This article is an excerpt of a talk given before the Board's conference on energy conservation policy, September 30, 1975, in New York City.

The problem of promoting energy conservation is considered to be a problem of information transfer. The purpose of energy policy is to close the gap between increasing demand and decreasing supply according to what method is cheapest, environmentally acceptable, and fastest. Conservation is quick, available now, and desirable from an environmental standpoint, but, most important, it is economical. This paper shows examples of conservation investments (e.g., thermal insulation, preheaters, more efficient automobiles, and heat exchangers) that pay off in terms of the cost of the energy saved compared to initial cost of installation. Whether conservation standards should be voluntary or mandatory depends on the number of people involved in establishing a standard and the complexity of the standard. For most products voluntary standards are considered the best approach. (BYB)

8809 Role of Federal R and D in industrial energy conservation. Savitz, M.L. (Energy Research and Development Administration, Washington, DC). *Conference Board Record;* **12**: No. 12, 52-53(Dec 1975).

This article is drawn from remarks made before the Board's conference on energy conservation policy, September 30, 1975, in New York City.

The Energy Research and Development Administration's (ERDA) industrial energy conservation program (as stated in the report submitted to Congress, 'Creating Energy Choices for the Future') is described in this article. ERDA's conservation research efforts, which include technological, institutional, economic, and educational approaches, stress not only simple elimination of waste, but also emphasize more efficient use of energy. The overall goal of this conservation program is to significantly cut down industrial energy consumption with minimum adverse economic, social, and environmental impacts. The primary emphasis of the conservation effort is the analysis, design, experimentation, and implementation of economically feasible methods for increasing the efficiency of industrial processes. (BYB)

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 8116, 8777, 8780, 8806, 8807, 8859, 8864, 8867, 8868

8810 (PB—239773) **Economic impact of environmental programs. Summary report, November—December 1974.** (Council on Environmental Quality, Washington, D.C. (USA)). Dec 1974. 30p. NTIS $3.75.

The memorandum summarizes the Council's 1974 estimates and analyses. It includes (1) abatement costs for 1973-1982; (2) macroeconomic impacts of environmental expenditures on inflation; investment, productivity, economic growth; employment; government finances; foreign trade; and distribution of income; and (3) impacts on specific industries. (GRA)

8811 (PB—240008) **Impact of energy development on water resources in arid lands. Literature review and annotated bibliography. Information paper.** Bowden, C. (Arizona Univ., Tucson (USA). Office of Arid Lands Studies). Jan 1975. Contract DI-14-31-0001-4258. 288p. NTIS $8.75.

Water is basic to energy conversion systems, natural and man-made. Consequences of energy extraction and conversion in arid lands where water is scarce are explored. The historical past is utilized as a record for casting modern development plans into perspective; the worldwide growth in energy consumption rates is considered as the motive force behind many current energy projects in arid lands. Energy sources (coal, oil, gas, oil shale, solar energy, alternative energy sources, fission, fusion, and geothermal) are reviewed in terms of their consequences on the air, land, water, and inhabitants of such regions. Two rivers, the Colorado and the Missouri, provide small-scale models of the rewards and hazards of heavily exploiting water-short areas. In both instances, energy development plans, as now proposed, will seriously deplete the water supply, alter the quality of the water, land, and air, and increase the human population. (GRA)

8812 (PB—249544) **Public opinion survey on energy and economic considerations and air pollution. Highlight report. Volume XVI.** (Opinion Research Corp., Princeton, N.J. (USA)). 1976. vp. NTIS $4.50.

Results are presented of a telephone survey in which 511 people were asked questions on air pollution, particularly relating to the energy and economic factors of air pollution. Of those interviewed, 62% do not think that air pollution is a serious problem where they live, while 60% do feel that air pollution is related to some health problems. The most important causes of air pollution are thought to be motor vehicle exhausts, factories, and plants. Although many people are willing to pay money for less air pollution, people do not want to consume more energy for cleaner air (e.g., adding fuel-using anti-pollution devices to automobiles). In certain instances, people would alter their behavior (e.g., join car pools, turn thermostats down) to conserve energy and to lower air pollution rather than pay extra money. People seem to want to prevent significant deterioration of air quality. (BYB)

8813 Some economic aspects of conflicts over land use in the coastal zone. Rettig, R.B. (Oregon State Univ., Corvallis). *Coast. Zone Manage. J.*; **1**: No. 3, 291-303(1974).

Recent land use legislation pays particular attention to the coastal zone where age-old conflicts have recently accelerated. Flexibility is required in policy because visible conflicts are tied into complex physical and social systems that may require changing patterns of land use over time. Public policy is altering property rights and a thorough understanding of the economic and social roles played by those rights is required. Economic models can be used to understand some major changes such as types of alteration of the environment, but may be ignored or misused unless a better understanding of coastal decision processes is developed. (auth)

8814 ENERGY AND CLIMATE. Bolin, B. Stockholm; Sweden; Secretariat for Future Studies (1975). 57p. Secretariat for Future Studies, Fack, S-103 10 Stockholm, Sweden.

The effect that increasing energy production has on the climate of the earth is discussed. Man influences the climate in three ways: 1) all energy that man makes use of is eventually converted into heat that may affect the climate; 2) in energy production man is altering the physical, chemical, and biological processes that shape the earth's climate; and 3) man can change the natural environment with the large amounts of energy available to him, and thereby can possibly alter the climate. In order to provide background information on this problem, sections are included on the climatic system, climatic changes since the last glaciation, general circulation of atmosphere, and energy fluxes in the climatic system. Several theories which have been proposed to explain changes in climate are surveyed. Possible future local, regional, and global climatic changes caused by an increase in energy production are considered. (25 references) (BYB)

8815 EPRI's environmental program. Comar, C.L.; Kornberg, H.A. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.*; **37**: 598-604(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

EPRI's environmental program supports on-line and developing technologies to ensure that the technologies required for electric power production and use are implemented in a way that is environmentally acceptable. A further role is to provide information and guidance prior to development of hardware for pollution control so that technology will be called upon to accomplish only what is meaningful and necessary. There is a need for knowledge of actual effects that may be produced, either detectable or undetectable but occurring at high probabilities; data on dose-response relationships at ambient or prescribed levels; infor-

mation on the costs of reducing levels; and public understanding of the tradeoffs among certain biological risks and costs so as to permit choice and acceptance of alternatives. The Environmental Assessment Program covers three areas: environmental areas, industrial processes associated with energy production and use, and program categories of environmentl research. Seven operational categories discussed are: identification, characterization, and monitoring; transport and interactions; effects on ecological systems and materials; effects on human beings; beneficial uses of waste products; cost/benefit and cost/effectiveness analyses; and data bases. (MCW)

8816 Evaluation of the impact on a utility to comply with EPA water pollution control plans. Mueller, N.N. (Commonwealth Associates, Inc., Jackson, MI). *Proc. Am. Power Conf.*; **37**: 619-628(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

In 1972, the Federal Government passed PL 92-500, called the Federal Water Pollution Control Act. An amendment, PL 93-207, called the Spill Prevention Control and Countermeasure (SPCC) Plan was passed on December 28, 1973. On October 8, 1974, Federal Register, Volume 39, Number 196, was issued covering a second amendment, PL 93-243, that was passed on January 2, 1974, and known as the National Pollutant Discharge Elimination System (NPDES). The SPCC and NPDES programs define the legal requirements for a utility to be in compliance with Federal regulations. A Midwestern utility with facilities on both rivers and lakes having a generating capacity of over 4000 MW, provided by 32 boilers, 23 turbines, seven combustion turbines, and several diesel generating units, is used as an example to examine the impact to comply with these laws. It is concluded that the utility will have to invest huge sums of monies in engineering and equipment to comply with the Federal Water Pollution Control Act. Using an average cost of $31/kW for the 4000-MW utility, the total estimated compliance cost for both SPCC and NPDES is $129 million. (MCW)

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 8788, 8811, 8828

8817 Updata on today's energy picture. Carlson, J.W. (Department of the Interior, Washington, DC). *Proc. Am. Power Conf.*; **37**: 40-49(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

An update on supplies of energy and minerals is presented, and the establishment of adequate supplies over the long term is projected. The U.S. Department of the Interior is responsible for the Bureau of Reclamation, Bonneville Power, Southwest Power, Alaska Power, and the Defense Electric Power Administration if it is needed. The author describes the impact of recent events on consumers of electric power, on operators of electric power systems, and on investors in electric power. The barriers that have to be overcome to ensure sufficient electric power in the future to free the U.S. from the high cost of interruptible fuel supplies from abroad are delineated. The author indicates that the U.S. has to go toward Project Independence (independence by 1985). The President sees that electric power has to play a larger role with its energy use at 40 percent, instead of the present 30 percent. That means a doubling of output, and when the output of electricity is doubled, usage of oil and natural gas would go down. There would be a modest increase for hydroelectric and geothermal power, but the big increases come in coal, 100 percent increase, or 200 percent in terms of electricity fueling of the industry, and 400 percent in the case of nuclear. (MCW)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 8289

COAL

REFER ALSO TO CITATION(S) 8167, 8168, 8191, 8192, 8253, 8762, 8795

8818 (NP—20653) **Kentucky's coal manpower: an updated assessment of needs and availability for increased coal production through 1985.** (Spindletop Research, Lexington, Ky. (USA)). Dec 1974. 60p. TIC.

Kentucky, the leading coal producing state, can double production by 1985 if problems from several constraints can be met. Although there are enough workers, Kentucky's most serious problem is a shortage of skilled, technically competent manpower. Other constraints are transportation of coal, shortages of equipment and supplies, and capital needs. Potential problems include the development of reserves in remote areas, labor relations, regulatory effects, and public attitudes. Recommendations to eliminate manpower shortages stress on-the-job training and vocational school training. Other recommendations call for an improvement in technology, equipment, and management practices. An advisory task force to the Kentucky Energy Council would be chaired by the Secretary for Human Resources, and would include representatives of coal, labor, and interested public agencies. Tables include county labor and mining statistics and a list of training facilities. (DCK)

8819 (ORNL-NSF-EP—86) **Costs of coal surface mining and reclamation in Appalachia.** Nephew, E.A.; Spore, R.L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 45p. Dep. NTIS $5.50.

Coal surface mining and reclamation costs in Appalachia are estimated as a function of reclamation quality, the angle of natural terrain, and the overburden-to-coal stripping ratio. When mining to a maximum stripping ratio of 20, the cost of providing minimally acceptable, or basic, reclamation is estimated to be $0.49, $0.95, and $1.50/ton of coal mined, for 15°, 20°, and 25° terrain, respectively. The cost of providing full reclamation under the same conditions is estimated to be $1.59, $3.27, and $5.51/ton of coal mined. The cost of reclamation is also found to increase with the stripping ratio. When mining to a maximum stripping ratio of 30, the cost of providing basic reclamation is estimated to be $0.65, $1.25, and $1.98/ton of coal mined, for 15°, 20°, and 25° terrain, respectively. The cost of providing full reclamation under the same conditions is estimated to be $2.09, $4.13, and $7.26/ton of coal mined. Hence, independent of the stripping ratio, the cost of basic reclamation on 25° terrain is roughly the same as full reclamation on 15° terrain. An empirical formula is presented for predicting coal production and reclamation costs for other conditions of terrain angle, stripping ratio, and levels of reclamation quality. This study was performed to provide quantitative information to policymakers involved in the process of choosing among alternative regulatory programs.The mining and reclamation costs developed do not take into account possible limitations in available coal reserves. (auth)

8820 (PB—246210) **Windfall profits in the coal industry.** (Federal Energy Administration, Washington, D.C. (USA)). Feb 1975. 11p. (FEA-EATR—75-11). NTIS $3.50.

The President's energy program, which emphasizes coal over oil, could increase spot coal prices above $25.50 and create windfall profits of nearly $1 billion in 1974 and 1975. These profits, if they materialize, could be used to finance needed improvements and new development, and probably will not warrant a levy of windfall taxes. From a peak in 1970, profits have been declining from normal operations because increased labor, mine safety, and equipment costs were not met with proportional increases in coal prices. Losses, ranging from $0.04 to $5.50 per ton, in underground operations make utility markets less profitable than metallurgical and industrial markets. Loss of flexibility in responding to rising costs is due to long term contracts. Mine safety requirements ran 3 to 5 times greater than surface reclamation costs of $0.20 per ton. While surface operations were generally profitable, they did not offset underground losses. Any windfall profits will be short term, but do warrant federal monitoring. (DCK)

8821 (PB—247678) **Coal future: economic and technological analysis of initiatives and innovations to secure fuel supply independence.** Rieber, M.; Soo, S.L.; Stukel, J. (Illinois Univ., Urbana (USA). Center for Advanced Computation). May 1975. 227p. (NSF/RA/N—75/037). NTIS $8.00.

Five interrelated areas are covered in this summary document: (1) estimation and validation of nuclear power fuel cycle costs; (2) re-evaluation of low sulfur coal estimates, analysis of the reliability of published coal reserve/resource estimates and coal production possibilities; (3) estimation of comparative costs of coal transportation including unit trains, slurry pipelines and high pressure penumatic pipelines; (4) comparative cost and feasibility estimates of coal desulfurization by stack gas scrubbing and low Btu gasification; and (5) analysis of coal gasification to a medium Btu coal gas (300-350 Btu/scf). (Eight appendixes are available separately) (90 references) (auth)

8822 SECOND ANNUAL SYMPOSIUM ON COAL GASIFICATION, LIQUEFACTION, AND UTILIZATION: BEST PROSPECTS FOR COMMERCIALIZATION. CONFERENCE

HELD AT PITTSBURGH, PENNSYLVANIA, AUGUST 5—7, 1975. Pittsburgh; United States of America (USA); University of Pittsburgh (1975). vp. (CONF-750868—). $50.00.

From 2. annual symposium on coal gasification, liquefaction and utilization best prospects for commercialization; Pittsburgh, Pennsylvania, USA (5 Aug 1975).

Thirty-two items are included of which eight resulted from ERDA sponsorship. An abstract was prepared for each of these eight papers. (EJH)

8823 COAL SLURRY PIPELINE LEGISLATION. HEARINGS BEFORE THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS, HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION ON H.R. 1863, H.R. 2220, H.R. 2553, AND H.R. 2986. Congressional Committee Print No. 94-8. Washington, DC; United States of America (USA); Committee on Interior and Insular Affairs (1975). 1265p.

Full committee hearings were held to consider legislation to permit construction of coal slurry pipelines. The 18 sponsors of the proposal anticipate this inexpensive, efficient, environmentally sound transportation system will stimulate increased coal development and help meet national needs. Proposed legislation will allow coal pipeline developers to acquire rights of way by eminent domain, subject to environmental criteria. With the major part of the pipeline underground, environmental and esthetic damage will be minimized. Less power will be required than if the coal were converted directly to electrical power at the mines. Eleven agency reports, 48 statements, 96 letters, and additional reports and studies are presented. Recommendations include a single rather than dual regulation agency, stronger certification safeguards, analysis of the effect on other transportation media, and a thorough analysis of the impact on water and water rights. The texts of the four bills under consideration are included in this document. (DCK)

8824 EPRI program plan for resource extraction and preparation. Schmidt, R.A. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.*; 37: 295-308(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

EPRI has been conducting a coal program to stimulate development of technological alternatives that will ensure reliable coal supplies of adequate quantity and quality for electric utility use at the lowest practical cost. The principal elements of EPRI's R & D plan in the resources sector for the remainder of the 1970's, emphasizing program structure and content, are summarized. The purpose of the program is to provide support to the electric utility industry through improved understanding of the technical factors that control or influence production and availability of essential fuels and quality of those fuels with respect to utility requirements. The scope of the resources program covers the sequence of interdependent operations and activities by which resources are produced for electric utility use. Included are the technology and practice of exploration and reserve definition; deposit development and production; treatment, preparation, and transportation; and rehabilitation and pollution control. The approach of the program is to negotiate contracts with qualified investigators and organizations to perform specific projects, and to conduct independent analyses in resource areas of importance to the electric utility industry. The results furnished by the contractors will be made available to government bodies and to the general public. (MCW)

8825 IOWA COAL RESEARCH PROJECT. SECOND ANNUAL PROGRESS REPORT, JANUARY 15, 1975 TO JANUARY 15, 1976 TO THE GENERAL ASSEMBLY OF THE STATE OF IOWA. Ames, IA; United States of America (USA); Iowa State University (1976). 43p. (IS-ICP—14). EMRRI Document Library, Room 201 Spedding Hall, Iowa State University, Ames, IA 50011.

A second annual progress report reiterates goals of establishing environmentally sound methods of strip mining, processing, and transporting coal in Iowa. New goals, chemical desulfurization and processing of coal and the development of new prospecting methods, were added this year. Mine 31, which began operating near Bussey in July 1975, is using several new techniques including a bulldozer with ripper tooth, sale of coal on a Btu rather than weight basis, a formal mining plan, and environmental site monitoring. By June 1977 mining operations of 135,000 tons and land replacement of 35 acres to productive use will be complete. A coal refining plant is near completion at a site adjoining the Iowa State University power plant. Environmental assessment was made before mining commenced at the demonstration mine and will be compared with post-mining conditions. A regional competition economic model is in use. The report recommends continuation of the projects to demonstrate a capability for self support and to prepare Iowa for curtailment of natural gas. Deep mine projects are recommended. (DCK)

PETROLEUM

8826 (FEA/B—76/050) **Effects of decontrol.** (Federal Energy Administration, Washington, D.C. (USA). Office of Policy and Analysis). 18 Aug 1975. 50p. NTIS.

Five background papers contained in this report summarize the effects of decontrol of old oil on the economy, domestic production, and imports, as well as the effect of price on demand and the impacts without new action. The economic recovery will continue strongly even with decontrol. Decontrol will help stem the decline in domestic production by providing incentives for tertiary recovery and by reducing the adverse effect inflation has on the $5.25 ceiling price. Depending upon the world price of oil, decontrol could increase production by 1.1 to 2.8 million barrels per day (MMB/D) in 1985 and 0.1 to 0.3 MMB/D in 1977. Compared with taking no actions, the President's actions on decontrol and import fees will reduce imports by about 150,000 barrels per day by the end of 1975 and almost 700,000 barrels per day in 1977. Analysis of energy consumption trends as well as econometric analysis firmly indicates that higher energy prices encourage conservation. (GRA)

8827 (AD/A—012808) **Petroleum transportation systems study. Chapter IV. Petroleum demand forecasts.** (Robert R. Nathan Associates Inc., Washington, D.C. (USA)). Apr 1975. 113p. NTIS.

Report prepared for Army Institute for Water Resources; a supplement to a Department of Transportation report entitled 'Economic Aspects of Refinery and Deepwater Port Location in the United States' (PB-236701 - PB-236705, NTIS).

The overall study, of which this is a part, is concerned with the development of a systems approach to analysis of total economic costs of alternative deepwater port, refinery, and transport combinations for crude oil and refined products. This chapter presents the basic analysis and projection of demand for refined products by state. (GRA)

8828 (GS-B—1411) **Latin America's petroleum prospects in the energy crisis.** Grossling, B.F. (Geological Survey, Washington, D.C. (USA)). 1975. 44p. GPO, Stock No. 024-001-02694-5.

Next to the Middle East and Africa, Latin America is the third largest net exporter of oil. Methods used to estimate the extent of remaining oil resources are not adequate. Although Latin America has 19% of the world prospective petroleum area, it now produces only 9% of the oil. In Latin America a large part of crude oil resources is yet undiscovered. Ultimate recovery for Latin America is estimated to be 490 to 1,225 billion barrels of oil and 2,450 to 6.370 trillion cubic feet of gas. Published information on Latin America's resources are thought to grossly underestimate its energy resource potential. This report approximates that the energy resource base of Latin America is two times that of the U.S. Although some industries' projections for remaining world petroleum resources forecast that these resources would be exhausted by the year 2008, this study estimates resources to be two to five times larger. However, exhaustion would be delayed only a few decades beyond 2008. The principal energy options for Latin American countries seem to be: development of onshore oil resources (Bolivia, Peru, and Colombia); development of offshore oil resources (Argentina and Caribbean countries); coal liquification and coal gasification (Chile and Colombia); shale oil (Brazil); and bituminous sands (Venezuela and Colombia). (13 references) (BYB)

8829 (NP—20644) **Outer continental shelf oil and gas development: improvements needed in determining where to lease and at what dollar value. Report to the Congress by the Comptroller General of the United States.** (General Accounting Office, Washington, D.C. (USA)). 30 Jun 1975. 57p. TIC.

Recommendations are made by the General Accounting Office (GAO) to the Secretary of the Interior for improving the Federal Government's program for deciding where to lease potential offshore oil resources and at what dollar value. These recommendations call for an exploration program for a systematic planned appraisal of the Outer Continental Shelf (OCS) reserves. Federally regulated and financed industrial involvement in this resource appraisal is recommended. Periodic assessment of economic values used in valuing the resources and adjustment of these values in light of current information are emphasized. It is pointed out that the frequency of leasing should be such as to give the Department of the Interior adequate time to consider all data from OCS appraisal studies. The establishment of a test program to evaluate, offer, and lease entire geological structures--as opposed to the current tract leasing policy--is suggested. The Department of the Interior voiced criticism of some of the recommendations, and a letter expressing the sentiments of the Department is attached. Responses from the Department of the Interior to each of the recommendations are also attached. (BLM)

8830 PRESIDENT'S DECONTROL PROPOSALS. HEARINGS BEFORE THE SUBCOMMITTEE ON ENERGY AND POWER OF THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE, HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION. Congressional Committee Print No. 94-49. Washington, DC; United States of America (USA); Committee on Interstate and Foreign Commerce (1975). 900p.

Testimony in five days of hearings was recorded on extension of controls on the price of 'old oil,' two gradual decontrol plans presented by the President, the potential for an override of a possible veto of legislation to extend controls, and economic and conservation aspects of decontrol. The testimony seemed to reflect the tug-of-war situation between the President and Congress on the decontrol issue. Witnesses representing independent oil companies, airlines, electric utilities, labor unions, and a farmers' union along with Ralph Nader and economists testified that decontrol of 'old oil' prices would result in more inflation, more unemployment, and more recession. A figure of $900/year for a family of four is proposed as the individual cost of such decontrol. Both the President's 30-month and 39-month decontrol plans are defended by members of the Federal Energy Administration and the President's Council of Economic Advisers. Representatives of some independent oil companies and service station organizations proposed a temporary extension of controls followed by a gradual decontrol as a compromise plan. (BLM)

NATURAL GAS

REFER ALSO TO CITATION(S) 8829

8831 (NP—20646) **Alaskan natural gas transportation systems. A report to the Congress, pursuant to Public Law 92-153.** (Department of the Interior, Washington, D.C. (USA)). Dec 1975. 253p. TIC.

In response to the Trans-Alaskan Oil Pipeline Authorization Act, hypothetical transportation systems from the North Slope of Alaska to the lower 48 states were studied in order to evaluate two competing applications. One proposal is a trans-Canadian pipeline system for natural gas and the other a pipeline/cryogenic system using tankers to transport liquified gas (LNG). Feasibility was limited to economic and technological considerations. The trans-Canada system, proposed by the Arctic Gas Study Group, would require a capital outlay of $10 to 12 billion, with an additional $1 billion to extend pipelines to California and Pittsburgh. Shrinkage factor would be 6.4%, and benefit minus cost, $8.7 billion. Construction risks would be higher than for the LNG system. The Alaska LNG system, proposed by El Paso Alaska Co., would require a $9 to $11 billion capital outlay. Shrinkage would be 11%, and benefit minus cost $7.8 billion. Operation would require more risk and operating costs would be higher because of liquefaction facilities. Both systems would have a lead time of 5 1/2 years. Net economic benefits would be affected by configuration of the network, delays in government permits, legal challenges, labor, and climatic conditions. (54 references) (DCK)

8832 (NP—20647) **Natural gas shortage.** (Virginia Energy Office, Richmond, Va. (USA)). 17 Sep 1975. 29p. TIC.

Data are presented on the natural gas shortage, its economic impact in winter of 1975/76, and proposed Congressional action. The shortage, which is most severe in the winter, has been increasing at a rapid pace. Even with natural gas deregulation, shortages will probably grow for several years. Economic impact of the shortages will most likely be centered in about 10 to 15 states, including the mid-Atlantic coast states and others such as Ohio, West Virginia, Pennsylvania, and Kentucky. The Natural Gas Emergency Standby Act of 1975, submitted by the Administration, has the following titles: Interstate Pipeline Emergency Natural Gas Purchases; Curtailed Consumers Emergency Natural Gas Purchases; Emergency Energy Supply and Environmental Coordination Act Amendments; and Propane Standby Allocation. In Virginia the amount of gas delivered in the 1975/76 winter will be 17% less than the volume delivered in 1974/75. This curtailment will adversely affect the industrial and commercial sectors in some sections of the state, particularly in the stone, clay, glass, paper, and textile industries. Except for a few plants, oil, coal, or propane can be substituted for natural gas. Many of the 1,000 small and medium commercial and industrial customers who could be subjected to curtailment do not have alternate fuel capabilities. (BYB)

8833 (NP—20698) **Natural gas deregulation analysis.** Hogan, W.; Huntington, H.; Knapp, D.; Kraft, J.; Neri, J.; Nissen, D.; Rodekohr, M.; Sweeney, J. (Federal Energy Administration, Washington, D.C. (USA). Office of Policy and Analysis). 23 Jan 1976. 34p. (FEA—76-3). TIC.

Deregulation of natural gas will cause prices to rise; higher prices will induce higher production. Without deregulation interstate consumers of gas will suffer much more from declining gas production than intrastate consumers. If natural gas wellhead regulation continues at current real prices, total domestic production could decline from 21.6 TCF in 1974 to an estimated 18 TCF in 1985. However, if new contracts are deregulated, 1985 production could increase to 22.3 TCF. It is also pointed out that gas shortages increase oil consumption and oil imports. The costs of natural gas deregulation in the short- and long-term are discussed. The long-run effects of gas deregulation on residential fuel bills are estimated for some of the proposed legislation. Current regulations have caused a reduction in interstate sales from over 13 TCF to 11.6 TCF in 1974. The various legislative options for deregulation would maintain or increase sales to interstate markets without decreasing the volume of intrastate sales. (BYB)

8834 Gas is vital factor in energy solutions. Willis, R.H. (Connecticut Natural Gas Corp., Hartford). pp 239-246 of In Proceedings of sixth synthetic pipeline gas symposium. Arlington, VA; American Gas Association (1974).

From 6. synthetic pipeline gas symposium; Chicago, Illinois, United States of America "USA" (28 Oct 1974).

See CONF-7410147—.

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 8778, 8779

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 8559, 8859, 8864, 8865

8835 (NP—20648) **Nuclear controversy international.** Doderlein, J.M. (Institutt for Atomenergi, Kjeller (Norway)). Sep 1975. 39p. TIC.

The societal and philosophical background for the nuclear power debate is presented. The critics of nuclear power are defined, and their tactics are described. The issues of the nuclear debate are delineated. From past experiences, the mistakes of the proponents are pointed out, and future strategies to overcome these mistakes and to overcome the critics are outlined. A survey is made of the current status of the nuclear controversy in Norway, Sweden, the United States, and Germany. (BLM)

8836 NUCLEAR POWER TO 1985: POSSIBLE VERSUS OPTIMISTIC ESTIMATES. PRELIMINARY REPORT. Rieber, M.; Halcrow, R. Urbana, IL; United States of America (USA); University of Illinois (1974). 201p. (CAC—137P). Center for Advanced Computation, University of Illinois at Urbana-Champaign, Urbana, IL 61801.

This preliminary report delineating costs of nuclear power will be used to set comparison standards for coal contracting. Cost estimates for 1980 generation of electricity by nuclear power are compared with previous forecasts by the Atomic Energy Commission (AEC), Arthur D. Little, Inc., and other agencies. Construction and financing problems are lowering predicted output. Forecasts in this study are based on an 8- to 10-year lag from inception to production. Changes and delays in regulatory procedure (including lawsuits), delays in equipment delivery, low labor output, and strikes are the major causes of lengthened construction times. Estimates of percent load factor in nuclear plants were lowered from 80% to 60-70%, which reduces cost advantages over fossil fuels. A detailed methodology is presented for estimating fuel cycle costs from the mining to recycling stages. These figures are double former AEC estimates. Over 50 graphs and tables illustrate cost estimates and comparisons. Costs analyses in this report are partially qualitative because of inconsistent reporting and accounting methods. (DCK)

8837 Supplying the six. Oboussier, F. (Director General, Euratom Supply Agency). *Nucl. Act.*; No. 13, 22-26(Jul 1975).

Under the Euratom Treaty, the European Community must ensure that all users in the Community receive a regular and equitable supply of ores and nuclear fuels. Supply to users in the Community of ores, source materials, and special fissile materials is based on the principle of equal access of the users to the supply sources. To ensure such equal access, the Treaty prohibits all practices designed to secure a privileged position for certain users. In addition, an agency has been set up with two essential rights--that of an option on all ores, source materials, and special fissile materials produced in the territories of the Member States; and the

exclusive right to conclude all contracts relating to the supply of ores, source materials, and special fissile materials coming from inside the Community or from outside. Dealings of the Agency with outside agencies, especially the former US AEC, are described. The uranium market and its economics and the availability of special fissile materials are summarized. (MCW)

8838 REVIEW OF NATIONAL BREEDER REACTOR PROGRAM. REPORT BY THE AD HOC SUBCOMMITTEE TO REVIEW THE LIQUID METAL FAST BREEDER REACTOR PROGRAM OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES. Washington, DC; United States of America (USA); Joint Committee on Atomic Energy (1976). 157p. GPO $2.20.

The ad hoc committee, chaired by Rep. Mike McCormack, recommends that the breeder reactor program be pursued with urgency. The review included analyzing questionnaire responses of over 90 organizations and individuals, public briefings and hearings, and visits to breeder reactor sites in several countries. Major conclusions are: (1) continuation of the breeder program should be given high priority; (2) commercially available breeders will be needed by the 1990's; (3) demonstration LMFBR plants are essential; (4) research on the safety and environmental impacts of commercial breeders should have top priority; (5) reliance on foreign technology should be limited to exchanging information; and (6) review of breeder development plans should not delay the program. The committee also recommends funding research and development of alternative sources of energy. (DCK)

8839 Nuclear controversy and the limitations of decision-making by experts. Holdren, J.P. (Univ. of California, Berkeley). *Bull. At. Sci.;* **32**: No. 3, 20-22(Mar 1976).

Policy makers must stop waiting for technical consensus where none is possible, and concentrate instead of how to minimize the social costs of uncertainty. The author feels that the California Nuclear Safeguards initiative presents such an opportunity. Answers are not in unison about the toxicity of plutonium, the probability of certain kinds of reactor accidents, about damage a large accident wuld cause, or about the adequacy of various proposals for the management of radioactive wastes. The author explains why he believes the inability of experts to agree on such issues exists for such matters as power plant security and safeguards for special nuclear materials; he then explains what it means for the formation of nuclear policy in general. The toughest questions cannot be resolved by technical expertise, but the experts should clarify the options and the range of technical uncertainty as best they can. The public-policy question in the nuclear controversy deals mostly with weighing risks against benefits; for example, weighing the high routine impact of some technologies (e.g., burning coal) against the small chance of a big disaster associated with others (e.g., nuclear reactors). This places the major decisions in the hands of those most directly accountable to the public through the political process. The California initiative is explained in detail. (MCW)

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 8116, 8254

8840 (NBS-SPEC.PUBL.—419) **Selected topics on hydrogen fuel.** Parrish, W.R.; Voth, R.O.; Hust, J.G.; Flynn, T.M.; Sindt, C.F.; Olien, N.A. (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1975. 212p. GPO $2.80, SD Catalog No. C13.10:419.

The National Bureau of Standards played a vital role in developing hydrogen technology for the space age and is now engaged in efforts to adapt and improve this technology for the commercial use of hydrogen fuel. This document is a summary report on selected hydrogen-fuel topics and was prepared to identify cost and technical barriers to the commercial use of hydrogen fuel and to generate reference data for policy-planning, decision-making and design. Cryogenic hydrogen fuel technology is emphasized in the economic and systems analyses reported herein. Using the best available technical and economic data, hydrogen fuel is not currently cost competitive with alternate fuels; however, we must not reject hydrogen on the basis of current economic comparisons. Increased efficiencies of production, liquefaction, and energy conversion may drastically change these comparisons-of-today as will increased fossil fuel prices and more stringent environmental and pollution constraints. Hydrogen appears currently marketable in certain integrated utility systems, in transoceanic transport of energy produced far at sea, and is a necessary element in a wide variety of growing industrial processes and in the liquefaction of coal. This publication identifies research and development needs within selected areas of NBS competence and future research plans are outlined. (314 references) (auth)

8841 HYDROGEN. HEARINGS BEFORE THE SUBCOMMITTEE ON ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY, U.S. HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION. Congressional Committee Print No. 29. Washington, DC; United States of America (USA); Committee on Science and Technology (1975). 1368p.

Hydrogen, its production, utilization, and environmental effects, was the subject of hearings chaired by Rep. Mike McCormack. The possibility of widespread use of hydrogen energy in the late 1990's exists, given significant changes in energy systems. A system approach is called for in building on existing technology. The advantages of hydrogen are its cleanliness, its ability to use modified pipelines, and the fact that water is its main by-product. Problems to be solved include safe storage methods, economical production, effects on structural materials (some steel, for example, is embrittled by hydrogen), and unknown environmental hazards. Speaking for expanded R and D were (1) Dr. James Kane of ERDA, which is concentrating on synthetic fossil fuels; (2) Dr. Harrison H. Schmitt of NASA, which has used hydrogen fuel for 20 years; (3) Dr. James Funk of the University of Kentucky, which is investigating production methods; (4) Dr. Paul Petzrick of the Naval Energy, Research and Development Office; (5) Dr. Derek P. Gregory of the Institute of Gas Technology, who urged that hydrogen research not be 'lost' under too much review and planning; and (6) Dr. Sidney H. Law of Northeast Utilities, who stressed the potential hydrogen has to supplement electricity as an energy carrier. (DCK)

8842 Hydrogen: the ultimate fuel. Dell, R.M.; Bridger, N.J. (Atomic Energy Research Establishment, Harwell, Oxfordshire, UK). *Applied Energy;* **1**: No. 4, 279-292(Oct 1975).

Hydrogen is regarded in certain quarters as the ultimate, non-polluting fuel and energy storage medium for future centuries. This view is based upon a scenario in which fossil fuels are reserved for chemical use, while other primary energy sources are employed to generate hydrogen from water. This paper reviews briefly the prospects for such a future and outlines the technical and engineering problems to be solved and the economic disincentives in terms of present-day fuel prices. Likely trends in hydrogen production technology are discussed, followed by a consideration of hydrogen storage, either as liquid hydrogen or in the form of metallic hydrides. Future uses of hydrogen are reviewed, first as a chemical in industry, then as a fuel for heating purposes, and finally as a portable fuel for aircraft and road vehicles. In reaching a conclusion as to the prospects for hydrogen, the importance of timescales is emphasized, together with likely technical developments in the primary energy sectors. (13 references) (from Summary)

UNCONVENTIONAL SOURCES AND POWER GENERATION

SOLAR

REFER ALSO TO CITATION(S) 8384, 8385, 8386, 8778, 8779

8843 (COM—75-11070) **Solar heating and cooling of buildings: methods of economic evaluation.** Ruegg, R.T. (National Bureau of Standards, Washington, DC (USA). Institute for Applied Technology, Center for Building Technology). Jul 1975. 47p. (NBSIR—75-712). NTIS.

Economic issues important to the design, and evaluation of solar heating and cooling systems in buildings are addressed in this report. It explains and illustrates with simple but realistic examples the use of life-cycle cost analysis and benefit-cost analysis to evaluate and compare the economic efficiency of solar and conventional energy systems. It also explains the conditions for making cost-effective trade-offs in solar system/building design. By presenting the basic methods and assessing the appropriateness of alternative assumptions, the paper provides a resource document for researchers and analysts. (12 references) (auth)

8844 (PB—238189) **Putting the sun to work: a history and directory of currently available solar energy applications.** Bacher, K. (Arizona State Fuel and Energy Office, Phoenix (USA)). 1974. 30p. NTIS $3.75.

A brief history of solar thermal energy is provided and a directory is presented of current economically and technically feasible applications. Heliothermal systems for water and space heating are at the present time more practical for short-term private and commercial uses than helioelectric and heliochemical

systems. Basic background information on the use and construction of solar equipment is followed by a listing of company names, addresses, prices, and specifications. Information is provided on hot water heaters, collectors, swimming pool heaters, total home systems, glazing systems for solar control, wind power, and solar cells. A bibliography of 20 books and articles on the experimental applications of solar energy is included. (DCK)

8845 (PB—243908) **Workshop on solar collectors for heating and cooling of buildings. Proceedings of a workshop held in New York City, November 21-23, 1974.** Sargent, S.L. (ed.). (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). May 1975. 517p. (NSF-RA-N—75-019). NTIS $12.00.

Workshop was held in conjunction with the Winter Annual Meeting of the American Society of Mechanical Engineers.

This workshop, attended by approximately 500 people, was devoted to solar collectors for building applications. The purposes of the workshop were as follows: to assess the present state of collector development; to examine new design concepts; to identify promising directions for further R and D; to present results of collector performance tests in projects funded by the National Science Foundation (NSF), including advanced research projects and state-of-the-art projects; to propose standards, suggested by the National Bureau of Standards, for testing solar collectors; to evaluate different numeric collector models; and to describe solar collector programs funded by NSF/RANN (Research Applied to National Needs) and other government agencies. Formal presentations were delivered by researchers, industry representatives, and government sponsors. The meeting was organized into these Sessions: 1) Flat Plate Liquid Heating Collectors; 2) Flat Plate Air Heating Collectors; 3) Focusing Collectors; 4) Panel Discussion by Collector Manufacturers; 5) Collector Materials and Components; 6) Numerical Models; 7) Testing and Standards; 8) NASA and HUD Solar Energy Programs; 9) Panel Discussion by Collector Users; 10) Working Group Reports; and 11) Solar Energy Programs in Federal Agencies. (BYB)

8846 NATIONAL SOLAR ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAM: DEFINITION REPORT. SOLAR ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION ACT OF 1974. OVERSIGHT HEARINGS. HEARINGS BEFORE THE SUBCOMMITTEE ON ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY, U.S. HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION. Congressional Committee Print No. 30. Washington, DC; United States of America (USA); Committee on Science and Technology (1975). 519p.

These hearings were held to determine if pending levels of funding were consistent with programs proposed in the program definition for the Solar Energy Research, Development and Demonstration Act of 1974. Dr. John Teem, Assistant Administrator for Solar, Geothermal, and Advanced Energy Systems, presented the report (ERDA-49) for the proposed programs. Uncertainties in the report were pointed out, including questions on future budget levels and their effects on R and D programs and on making future projections of solar energy production. The ERDA programs were outlined with descriptions of technologies involved and plans for implementing the program. For each technology involved, ERDA's objective, outstanding technical and institutional problems, R and D, major milestones, and a utilization plan were noted. Included in Dr. Teem's presentation were comments on: 1) the responsibilities and relationships of ERDA with other organizations involved with solar energy; and 2) social and economic factors that are being studied by ERDA. The three levels of documentation planned by ERDA for the solar energy program are outlined. Much additional material related to solar energy is included in the appendix. (BLM)

8847 Solar energy: a view from an electric utility standpoint. Spencer, D.F. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.*; 37: 1082-1099(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

Solar energy alternatives may be classified as either technological conversion systems or natural collection systems. The technological systems include thermal conversion for heating and cooling of buildings and thermal conversion for electric power production and direct conversion systems such as photovoltaic conversion to electricity. The natural collection approaches include ocean-thermal gradients and wind energy, which can be used for electric power production, and also photosynthetic conversion to produce organic materials, with subsequent biological or chemical conversion of these materials to clean fuels such as methane. The major problems associated with the utilization of solar energy are economic, stemming from the diffuse, intermittent nature of the resource and the capital-intensive nature of systems necessary to convert solar energy to its useful forms. System lifetimes of 15 to 30 years are required to amortize the high capital investment and obtain competitive energy costs. This paper presents a review of three of the major solar energy alternatives: solar heating and cooling systems for buildings, solar-thermal systems for electric power production, and photovoltaic conversion to electricity. These are viewed from the standpoints of their present development status, present costs and projected cost-competitive requirements, the major issues or problems in utilizing solar energy, and market penetration estimates by the year 2000. 25 references. (from Introduction)

GEOTHERMAL

8848 (NP—20694) **Report to the Congress: problems in identifying, developing, and using geothermal resources.** (General Accounting Office, Washington, D.C. (USA)). Mar 1975. 78p. TIC.

The problems related to the identification, technological development, and use of geothermal resources are reviewed, and an assessment is made of the potential and progress of developing these resources as a source of both water and energy. Three government agencies--the National Science Foundation, the Department of the Interior, and the Atomic Energy Commission--have been involved in geothermal activities. The Federal budget for FY 1975 requested about $49 million for geothermal exploration, research, and development. It is difficult to determine the potential for large scale geothermal power generation because of: 1) a lack of information on the extent and locations of resources; and 2) unsolved technological and environmental problems. Estimates of possible electric power that could be generated from geothermal resources in the U.S. by 1985 range from 4,000 to 132,000 megawatts. The geothermal leasing program, under the U.S. Geological Survey, has not proceeded as rapidly as expected, due to lack of knowledge on characteristics of resources, early state of technology, and lack of information used in classifying resources. The Bureau of Reclamation is heading a program in Imperial Valley, California, for producing 10,500 megawatts of power and 2.5 million acre-feet of fresh water a year from geothermal brines. Several recommendations are made to the Secretary of the Interior to improve geothermal resource development. (BYB)

8849 GEOTHERMAL ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1974. OVERSIGHT HEARINGS: LOAN GUARANTIES. HEARINGS BEFORE THE SUBCOMMITTEE ON ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY, U.S. HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION. Congressional Committee Print No. 31. Washington, DC; United States of America (USA); Committee on Science and Technology (1975). 692p.

The Geothermal Loan Guaranty Program was enacted in 1974 to encourage commercial development of this new energy technology through federally guaranteed loans. Two days of hearings, chaired by Rep. Mike McCormack, were held to (1) review proposed regulations for implementing the program and identify needed changes and (2) examine the overlap of P.L. 93-410 (the Geothermal Energy Research, Development, and Demonstration Act of 1974) and the ERDA Authorization Bill, which will provide a $6 billion loan guarantee program. This review will serve as a model for the total loan program. There were eight witnesses, representing ERDA, Congress, and private industry, and 22 prepared statements from both the public and private sector. Areas of concern included: (1) lag time in funding; (2) requirements for environmental statements; (3) the extent of state and local participation; (4) patent implications; and (5) a possible slanting toward big business. (DCK)

OTHER

8850 (NP—20651) **Governor's task force on wood as a source of energy.** Lloyd, S. (Vermont State Governor's Task Force, Montpelier (USA)). 14 Aug 1975. 77p. TIC.

The Task Force unanimously concludes: 1) that enough surplus wood grows each year in Vermont forests to provide a significant portion of Vermont's energy requirements; 2) that the means to procure this wood and deliver it to where it can be converted to energy at a cost competitive with other fuels is at hand; 3) that the technology exists to convert this wood to energy; 4) that the various procedures involved can be conducted without damage to health or the environment, provided that continuous monitoring, study, and controls are maintained (in fact, substantial environmental benefits to Vermont forest land can result from large scale wood procurement operations, if conducted in accordance with proper forest management techniques); and 5) that Vermont's

economy could benefit from such a program as a result of increased employment and business opportunity, less reliance on costly imported fuels, and significantly higher yields to present and future forest owners. The Task Force unanimously recommends that positive steps be taken to encourage and assist in the development of a wood energy system in Vermont. (auth)

ELECTRIC POWER

REFER ALSO TO CITATION(S) 8491, 8817

8851 (NP—20636) **Electricity pricing in relation to the national interest. Testimony of Douglas C. Bauer before the Public Utility Commission of Colorado.** Bauer, D.C. (Federal Energy Administration, Washington, DC (USA). Office of Energy Conservation and Environment). 1975. 21p. TIC.

A national energy policy is discussed as it relates to Colorado and to the system and customers of the Public Service Company of Colorado. Proceeding from an assumed adequate aggregate revenue requirement, a structure of rates is presented that can best achieve economic efficiency and the optimum allocation of resources. No position is taken in this testimony relative to the level of rates necessary to cover the total costs of the utilities. The present situation and past decisions of the Public Service Company of Colorado relative to rate structures are reviwed. Implementation of structural rate reforms that embody peak responsibility pricing and time differentiated rates are deemed advisable by the Federal Energy Administration. The importance of these structural rate reforms--not only for Colorado, but for utilities across the Nation--is stressed. The effects of such rate structures on the economics of the electric utilities and on energy conservation are discussed. (BLM)

8852 (NP—20638) **Electricity pricing for North Carolina and the Nation. Testimony of Douglas C. Bauer before the North Carolina Utilities Commission.** Bauer, D.C. (Federal Energy Administration, Washington, DC (USA)). 1975. 15p. TIC.

A National policy on a more rational electric power pricing policy to conserve energy is discussed as it relates to North Carolina utilities and electric consumers. Structural rate issues are presented in terms of the rationale for peak load pricing, practical problems associated with implementation of such pricing, and proposed solutions for the problems. The practical problems include revenue instability, abrupt changes in cost to the consumer, and metering costs. The chief concern with the implementation of the peak load pricing is the metering costs for time-of-day rates for all customers. Several suggestions for allaying this concern (including interruptable rates for industrial customers) are introduced. A model case for aggressive peak management in utility systems is described, and the relevant savings in cumulative capital expenditures and in projected 1985 demands for retail electricity are set forth. (BLM)

8853 (NP—20640) **Electricity pricing for Wisconsin and the Nation. Testimony of Douglas C. Bauer before the Public Service Commission of the State of Wisconsin.** Bauer, D.C. (Federal Energy Administration, Washington, D.C. (USA)). 1975. 16p. TIC.

Comments recorded here are directed at two key reservations raised by Wisconsin industrial customers in response to the time-of-day electrical rate structure. These concerns are: (1) that the higher on-peak rates in time-of-day pricing will lead to substantially higher electric bills--discriminating against industrial customers; and (2) that adoption of time-of-day rates will place Wisconsin at a competitive disadvantage relative to industries in other states. Arguments are presented to allay the concerns and to point out how the use of time-of-day rates would benefit the entire country by conserving energy. (BLM)

8854 (NP—20642) **Brief of the Federal Energy Administration before the Public Utilities Commission of the State of California.** Sant, R.W.; Wilson, D.G. (Federal Energy Administration, Washington, D.C. (USA)). 2 Apr 1975. 28p. (FEA/D—75/463). TIC.

The national energy policy developed by the Federal Energy Administration (FEA) is presented as it relates to electric utilities with emphasis on the rate structure concept of peak load pricing. No views of the FEA on the amount of rate increase requested in these applications of the Pacific Gas and Electric Company (P G and E) is expressed. Key elements in a balanced demand and usage management program needed to promote the efficient use of all resources are set forth. Actions are described that utilities can take to implement peak load pricing schemes that will encourage customers to pay more attention to efficiency in purchasing and using electrical appliances. Wisconsin's approach toward peak load pricing is commended. P G and E's rate and load management techniques are compared graphically with those of two European systems--England and Wales and Berlin, Germany. Advantages of peak load pricing to P G and E and its customers are pointed out. (BLM)

8855 (NP—20650) **Analysis of recent electric utility rate increases.** Pifer, H.W. III; Scholl, E.L.; Speyer, J.M.; Zarubica, M. (Temple, Barker and Sloane, Inc., Wellesley Hills, Mass. (USA)). Jun 1975. vp. TIC.

The conclusions are summarized of an independent study to determine the total amount of electric utility rate increases during 1974 and the underlying reasons for these increases. The average rate increased 30% in 1974--from 19.7 mills/kWh to 25.7. Nearly 60% of this increase was directly linked to increased fuel costs--principally the rapid escalation of all fossil fuel prices following the Arab oil embargo in late 1973. Coal prices increased 68.5% during 1974. The most important non-fuel increase was the increase in the cost of capital. The dramatic increase in electric rates was not uniform as to type of customer nor geographic location. The impact with respect to customer type and location is discussed. The relative impacts due to environmental requirements, both on the fuel factors and non-fuel factors, are explored. Total environmental factors accounted for only about a 5% increase in the electric rates. (BLM)

8856 (NP—20655) **Independent staff analysis of the California Public Utilities Commission's report on ten-year forecasts of electric utilities' loads and resources.** (California State Energy Resources Conservation and Development Commission, Sacramento (USA)). 2 Sep 1975. 107p. TIC.

The technical evaluation of the California Public Utilities Commission's (CPUC) 10-year forecast of electricity loads and resources indicates that the CPUC forecast is subjective and judgemental. It is not based on the use of accepted analytical techniques, and neither the assumption nor the methodology were adjudged to be explicit. It is deemed impossible to estimate the reliability of the forecast, since it was inadequately documented. Wide variations in the forecasting techniques of the major public utilities and the CPUC are noted. The CPUC report is criticized for inadequately analyzing the implications of its forecasts and for not considering mandatory conservation measures. (26 references) (BLM)

8857 (PB—243920) **Digest of current research in the electric utility industry.** (Electric Power Research Inst., Palo Alto, Calif. (USA)). May 1975. 122p. NTIS $5.25.

A major objective of the Electric Power Research Institute (EPRI) is to be a prime resource for information on scientific research and development activities in the field of electric energy. In response to this objective, EPRI has developed the Research and Development Information System (RDIS), which is a computerized data base of research projects sponsored by the Institute and by individual electric utilities throughout the United States. RDIS provides the utility industry with a single, authoritative source of continuously updated information concerning in-progress, unpublished R and D projects. The program was initiated in 1974 and developed with the assistance of the EPRI Research Advisory Committee. This Digest is generated from the RDIS program. Contributors to this pilot volume were Consolidated Edison, EPRI, Pacific Gas and Electric, Philadelphia Electric, Southern California Edison, Tennessee Valley Authority, and Union Electric. The Digest will be issued annually. (auth)

8858 UTILITIES ACT OF 1975. HEARINGS BEFORE THE SUBCOMMITTEE ON INTERGOVERNMENTAL RELATIONS AND THE SUBCOMMITTEE ON REPORTS, ACCOUNTING, AND MANAGEMENT OF THE COMMITTEE ON GOVERNMENT OPERATIONS, UNITED STATES SENATE, NINETY-FOURTH CONGRESS, FIRST SESSION ON S. 594, TITLE VII. Washington, DC; United States of America (USA); Committee on Government Operations (1975). 601p. GPO $4.95.

The main purpose of these hearings was to explore all factors contributing to the recent 200 to 300% escalation in utility costs to consumers and to determine what Federal legislation is called for to deal effectively with the problems. All parties involved in the current controversy over public utility rates--the administration, consumer representatives, state and local governments, regulatory utility commissions, and the public utilities--were heard. The four main points of Title VII of the Energy Independence Act of 1975 receiving much criticism from consumer groups were: the inclusion of construction work in progress in utility base rates; the 'fuel adjustment clauses'; a 5-month limit on rate case proceedings; and 'normalization' of a utility's tax savings. Different interpretations were placed on the term 'fuel adjustment clauses' and 'normalization' by the consumer groups and the utilities. These same four points were interpreted by the administration and the utilities as being necessary to rescue the utilities from escalat-

ing fuel costs, inflation, and interest rates. Plans proposed by consumer groups for customer relief from the spiraling utility costs include the Fair Share Rates (every customer pays the real cost of production of his consumed electricity) and lifeline, i.e., a flat rate set on a 450-500 kWh usage to provide basic electrical needs of a family. Much related material is included in the appendix. (BLM)

8859 ENVIRONMENTAL IMPACT OF SUPPLYING POWER TO THE CON EDISON SERVICE TERRITORY: 1975-1990. Freedman, A.K.; Cohen, J.C. New York; United States of America (USA); Citizens for Clean Air, Inc. (1975). 155p. Citizens for Clean Air, Inc., 25 Broad St., New York, NY 10004 $5.00.

The environmental impacts of electric power generation and transmission in the Consolidated Edison Territory (New York City and most of Westchester County) are assessed. Current capacity and plans for generation and transmission additions are described. In studying the environmental effects of Indian Point nuclear complex, it is concluded that 'the ramifications of nuclear power are beyond the scope of the complex technology from which nuclear power was born.' According to this report, problems in handling and transport of nuclear materials and in disposal of radioactive wastes demand consideration. Alternatives to once-through cooling are described. Selection of cooling systems should take into account protection of aquatic life as well as the efficient operation of the power plant. A major issue in considering air pollution is the effect of a possible nuclear moratorium in New York State, which would cause a shift to coal-fired plants and more SO2 emissions. Further conclusions express the needs for : 1) a sound methodology to identify potential power plant sites; and 2) an assessment of the environmental impact of high voltage 765 kV transmission lines. (BYB)

8860 Solving the problems facing the electric utilities. Hill, J.A. (Federal Energy Administration, Washington, DC). *Proc. Am. Power Conf.*; **37**: 9-14(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The dimensions of the current problems of attracting capital for utilities investment, of achieving more efficient utilization of capacity, of siting and construction of new power plants, and of utilities receiving a return on their investment large enough to enable them to continue their service to American consumers are examined. Federal actions that are being taken to help get the utilities out of their current state of malaise are described. The author concludes that positive electric power load management, through a system of cost-based pricing incentives and load controls, can achieve a balanced future both for total electricity usage and for peak demand. This would minimize the consumption of scarce fossil fuels in electricity generation, moderate the future need for construction of new capacity, improve utility revenues, and eventually reduce the need for rate increases to maintain utility viability. The FEA feels that is a reasonable, attainable objective for substantial electrification of the economy beyond 1985. (MCW)

8861 Educating the engineer for professional contribution to the new energy economy. Miller, C.F. (Federal Power Commission, Washington, DC). *Proc. Am. Power Conf.*; **37**: 86-89(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The education of a successful engineer is discussed. He must possess the originality and technical judgement necessary to design devices, systems, and processes that are: acceptable to the human environment; economical to construct and operate; reliable and safe in operation; too complex for lawyers, politicians and other obstructionists to understand; and miserly in consumption of energy. He must be able to read with comprehension, write well, and speak well. The failures of the secondary schools to properly prepare engineering students are cited. The author states that the electrical engineer who plans to enter the electric power field should be provided with courses in classical synchronous machine theory, transmission-line theory, polyphase symmetrical components circuit theory, power systems analysis, and power system stability theory. Other general engineering requirements are described. (MCW)

8862 Impact of recent developments on the future of electric power. Chew, B.B. (Federal Power Commission, Washington, DC). *Proc. Am. Power Conf.*; **37**: 978-985(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The emergency of the national energy crisis, the dramatic increase in electric power costs and capital requirements, the prospect of new national life styles, and the growing role of Government in the energy picture are making important changes in the electric power industry. Perhaps the most fundamental are the greater uncertainties of growth and energy supplies, stronger emphasis on technical advancement, and increased dependence on Government policies and actions.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 8791, 8806, 8815, 8816, 8824

8863 (NP—20637) Phasing out of natural gas and oil for electric power generation: Southwest Power Pool and Electric Reliability Council of Texas. Part I. Present electric utility program: 1975-1984. (Federal Power Commission, Fort Worth, Tex. (USA). Bureau of Power). Sep 1975. 44p. TIC.

The present electric utility program is reviewed for phasing out natural gas and oil as fuels for power generation in the areas of the Southwest Power Pool (SWPP) and the Electric Reliability Council of Texas (ERCOT). At the end of 1972 all generating equipment in those two systems was fired by natural gas. From that time to the present, conversion to oil firing has occurred. The data presented point out the imperative need for SWPP to switch as soon as possible to coal, lignite, or nuclear energy for power generation. Since ERCOT operates electrically isolated from all other systems in the nation, emphasis is placed on the need for ERCOT--as well as other small isolated municipal systems--to make arrangements at the earliest practicable date for an interconnection to a nearby major electric system with greater fuel flexibility. The conclusion is drawn that all electric systems now relying wholly or in part on natural gas and oil as fuels should not only continue but must accelerate their current rate of coal, lignite, and nuclear plant construction programs. Much data on electric power, supply, demand, generation, and fuel resources are tabulated. (BLM)

8864 (NP—20649) Air pollution health effects of electric power generation: a literature survey. (Institutt for Atomenergi, Kjeller (Norway)). Nov 1975. 180p. Dep. NTIS (US Sales Only) $7.60.

The relative air-pollution health effects of gas-fired, oil-fired, and uranium-fueled electric power generating plants are compared. Four methods that investigators have used to compare the relative health effects are reviewed. These methods are: (1) comparing pollutant mass emission rates; (2) comparing specific health effects; (3) comparing air quality standards; and (4) comparing overall risks. It is concluded that air quality standards should not be used to compare the relative impact of power plants, and that while the regression analysis discussed may be used to qualify air pollution effects, further statistical correlation work should use a greater variety of specific air pollution variables. Discussion is included on a method that has been agreed upon by international organizations for comparing pollution health impacts of nuclear power plants; no such method is available for fossil-fuel power plants. A literature review of pollutant emissions and their related health effects is included. (181 references) (BLM)

8865 (PB—246639) Siting energy facilities at Camp Gruber, Oklahoma. Executive summary. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 27p. (FEA/G—75/384R). NTIS $4.00.

Preliminary evaluation of Camp Gruber Military Reservation in Oklahoma shows it to be a feasible site for many types of large complex energy facilities. Applying standard siting criteria (sufficient land, water supply, atmospheric dispersion, market potential, low socio-economic and environmental damage, low labor and material costs, transportation facilities, and utilities), 24 appropriate uses are listed. These include power plants fired by oil, coal, and nuclear fuels and power plants using wind and solar energy. The absence of coal seams, uranium ore, oil shale, water falls, etc. make the site inappropriate for facilities requiring mining. Geological conditions preclude deep storage of wastes. Siting is acceptable to local residents if consideration is given to minimum interference with recreation areas. A comprehensive water supply system and an administrative plan for development of the energy center are called for. (DCK)

8866 (PB—247126) Siting energy facilities at Camp Gruber, Oklahoma. Volume I. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1975. 256p. (FEA/G—75/384A). NTIS $9.00.

This report is volume one of a preliminary study, contained in three volumes, on the feasibility of establishing a site for energy-producing and -consuming facilities at Camp Gruber, Muskogee, Oklahoma. This volume is a compilation and preliminary analysis of the basic and readily available data on the Camp Gruber site. It describes the features of Camp Gruber and its surrounding vicini-

ties that are important to its evaluation as an energy center. Data were obtained from a two-day site visit, literature, and personal interviews. There are four sections in this volume: 1) Characteristics of Camp Gruber; 2) Characteristics of Surrounding Territory; 3) Regional Economic and Industrial Climate; and 4) Radiological Impact of Generating Facilities. Appendixes present information on eastern Oklahoma seismic data; geology and resources of Camp Gruber; public attitudes; streamflow and water quality data for Arkansas, Grand, Illinois, and Verdigris Rivers; hydrological siting analysis for Camp Gruber; reservoir capacities; earthquakes and eastern Oklahoma; and references and sources of information. Several maps, tables, and charts are included. (133 references) (GRA)

8867 (PB—247127) **Siting energy facilities at Camp Gruber, Oklahoma. Volume II.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1975. 74p. (FEA/G—75/384B). NTIS $4.50.

A preliminary study, contained in three volumes, is presented on the feasibility of establishing a site for energy-producing and -consuming facilities at Camp Gruber, Muskogee, Oklahoma. This volume considers the basic criteria for siting various kinds of energy facilities and compares Camp Gruber's features to these criteria. The study sets forth some of the projected advantages and disadvantages of energy centers and attempts to indicate uncertainities which surround the implementation of the concept. It also hypothesizes what roles an energy center at Camp Gruber might fulfill. Likewise, it highlights major aspects of energy centers as they are presently perceived and identifies strengths and weaknesses of the Camp Gruber site as a potential energy center. (GRA)

8868 (PB—247128) **Siting energy facilities at Camp Gruber, Oklahoma. Volume III.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1975. 82p. (FEA/G—75/384C). NTIS $5.00.

This is the third volume of a preliminary study on the feasibility of an energy center at an abandoned World War II military reservation called Camp Gruber, near Muskogee, Oklahoma. The Federal Energy Administration's purpose for the study was to use a specific site to establish the principal technical issues and criteria involved in collecting a number of energy producing and consuming facilities at one location. The siting of such energy centers could significantly expedite construction of critically needed energy facilities, such as nuclear power plants, petroleum refineries, and coal liquefaction and gasification plants, and could also minimize environmental impacts and land use issues. This report presents an analysis of the impact of construction of the Camp Gruber center on nearby communities. Emphasis is placed on the communities of Muskogee, Fort Gibson, and Braggs, because these three communities are expected to experience the largest impact. (GRA)

8869 FOSSIL AND NUCLEAR 1000 MW CENTRAL STATION POWER PLANTS INVESTMENT ESTIMATES. New York; United States of America (USA); Ebasco Services Inc. (1975). 20p. Electric Power Research Institute, P.O. Box 10412, Palo Alto, CA 94303.

Investment estimates are developed for a coal-fired and an oil-fired steam electric power plant, and for a nuclear light water reactor plant; each plant consists of a single unit with a maximum net output of 1000 MWe. These estimates, which are of an order-of-magnitude quality, are based on equivalent assumptions concerning site, labor performance, and reference dates for cost data. Adjustment factors are provided for labor rates and productivity for different regions of the U.S. Adjustments to total plant investment are calculated for plants using mechanical draft cooling towers instead of natural draft cooling towers, and for plants which have a totally enclosed steam generator building instead of steam generators being of semi-outdoor construction. Investment estimates for the power plants are as follows: nuclear, $544,300,000; coal, $460,100,000; and oil, $217,700,000. (BYB)

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 8859

8870 Special report on transmission and distribution R and D progress. Greenwood, J. (Electric Power Research Inst., Palto Alto, CA). *Proc. Am. Power Conf.;* **37**: 1157-1163(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

An introduction first traces events that led to formation of the Electric Power Research Institute (EPRI). Then the author, who is project manager of the Transmission and Distribution Division (T and D) of EPRI, highlights the division's research progress, pointing out major milestones they face in the short-term future and the anticipated payoffs they visualize for the electric utility industry. The discussion is organized under the following sections: T and D program organization; AC overhead transmission; DC transmission; underground transmission (taped cables, extruded cables, compressed gas-insulated cables, cryogenic cables, and DC cable systems); distribution; and system security and control. (LMT)

TRANSPORT AND STORAGE

8871 (CONF-760112—1) **Battery research sponsored by the U.S. Energy Research and Development Administration.** Landgrebe, A.A.; Nelson, P.A. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 12p. Dep. NTIS $3.50.

From Symposium on United States lithium resources and requirements by the year 2000; Lakewood, Colorado, United States of America "USA" (22 Jan 1976).

An important part of the Energy Storage Program of the U.S. Energy Research and Development Administration is the development of storage batteries for load-leveling on electric utilities and automotive propulsion, and for application to new energy generating systems. The successful development of batteries for these purposes will provide significant savings of oil resources and will also have beneficial environmental effects. A very high manufacturing volume may be required for these batteries and the availability of the required raw materials is an important consideration. Lithium—aluminum/iron sulfide batteries show promise both for utility energy-storage batteries and electric vehicle batteries, and serious consideration should be given by the lithium industry to the availability of lithium resources. (auth)

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 8254, 8764, 8770, 8773, 8789, 8790, 8805, 8867

8872 (CAC/TM—48) **Energy content of traded goods: 1963, 1967, 1972.** Nelson, M.W.; Bullard, C.W. III. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Mar 1975. 38p. NTIS.

The development of U.S. trade data for 1972 is described at a level of detail compatible with the 368 sector input-output structure of the economy. Energy content of competitive imports and exports are compared to total U.S. energy use, and similar results are presented for 1963 and 1967. (14 references) (auth)

8873 (NP—20654) **Energy consumption in Georgia: 1973.** (Georgia State Energy Office, Atlanta (USA)). Mar 1975. 27p. TIC.

An examination of Georgia's energy use and distribution reveals areas where conservation programs and planning for shortages are needed. The state used 1,370.4 of the 75,561 trillion Btu consumed in 1973 in the U.S. In per capita consumption, the state ranked 20th in electricity, 30th in natural gas, and 35th in petroleum. Comparison charts show that residential/commercial and industrial consumption was below the national average, electricity was slightly above, and transportation was nearly 43% higher because of private automobile commuting habits. Use of coal and petroleum were above average, and natural gas, hydroelectric, and nuclear below average. Almost all of the coal (95.6%) brought into the state was used to generate electric power, and 65.6% of Georgia's natural gas was used by industry. Retail price indexes of all fuels show a steady increase from 1965-1973, with the largest increases in petroleum fuel $^{3}2$, fuel oil, and coal. Heating gas prices for Atlanta were average for metropolitan areas, and Georgia's range of net monthly residential electric bills was average for the country. (DCK)

8874 (PB—246129) **Review and analysis of gasoline consumption in the United States from 1960 to the present.** Condell, H.; Folan, R. (Department of Transportation, Cambridge, Mass. (USA). Transportation Systems Center). Sep 1975. 54p. (DOT-TSC-OST—74-43). NTIS $4.50.

A presentation and analysis are made of the monthly gas consumption data for each of the 50 states and the District of Columbia. The data, obtained from the Federal Highway Administration, cover the period from January 1960 through April 1974. Included is a series of charts containing a regression analysis performed on the selected data for each state, growth rates for each

state, and a ranking of the states with respect to different parameters. Also included is a series of graphs depicting monthly gas consumption for each state. (GRA)

8875 (UIUC-CAC-DN—147) **Regional patterns of energy consumption in the U.S.: 1967.** Van Arsdall, R.T. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Jan 1975. 144p. NTIS.

The goal of this research is to generate as accurately as possible the spatial patterns of direct energy consumption in the U.S. in 1967. The energy forms examined are coal, crude oil, refined petroleum products (distillates, residuals, etc.), electricity, and natural gas. The physical units are converted to Btu's, with regional values where available. National energy use data are used as controls. The system is disaggregated to 51 regions and 97 sectors, plus final demand. The sectoral breakdown of consumption is carried out as far as possible, with interpolation where necessary. The methodology, results, and data sources are evaluated. Results include: 1) direct energy consumption of distillate and residual fuel oils by 2-digit manufacturing SIC's (Standard Industrial Classification) in 51 regions; 2) direct energy consumption of each of 5 energy forms by 98 sectors in 51 regions; and 3) an overview of data quality. Recommendations for improvements in the data base and suggestions for future analytical research are included. (49 references) (auth)

8876 ANALYSIS OF ENERGY CONSUMPTION IN WYOMING. Harvey, E.F. NP-20802. Denver; United States of America (USA); Bickert, Browne, Coddington and Associates, Inc. (1975). 64p. Bickert, Browne, Coddington and Associates, Inc., 100 S. Madison St., Denver, CO 80209.

Prepared for Mineral Development Division, Department of Economic Planning and Development, State of Wyoming.

An overview of Wyoming energy consumption indicates certain differences compared with national data. Wyoming ranks first among all states in energy use per capita, or almost three times the national average. In 1972, the Wyoming per capita energy requirement was 988 million BTU compared with a national rate of 358 million BTU. This is primarily attributable to Wyoming's relatively large amount of thermal electricity generation. It is expected that the state's energy requirements per capita will continue to grow faster than the national rate. Wyoming's energy requirements per capita do not reflect actual final consumption, since most of the electricity production is exported. Transportation fuel and space heating are the most important end uses of energy followed by process steam and direct industrial heat applications. About 75 percent of all Wyoming housing units are single-family dwellings. Electricity and natural gas are the predominant energy sources. Energy consumption for the Wyoming commercial sector is generally consistent with other sources, though wide differences among states are evident. National data are given considerable weight in estimating energy requirements for Wyoming manufacturers. Fuel use for Wyoming's sugar refineries varies substantially from national figures. Mineral industries, especially petroleum refining, pipelines and trona, are energy-intensive. Wyoming's public sectors consume relatively little energy per employee. State government and higher education are the largest consumers with over 500 million BTU required per employee. (From Summary)

ENERGY CONVERSION

MHD GENERATORS

REFER ALSO TO CITATION(S) 9609

DESIGN AND DEVELOPMENT

8877 (FE—1760-2) **Development program for MHD direct coal-fired power generation test facility. Quarterly progress report for the period April—June 1975.** Dicks, J.B.; Tempelmeyer, K.E.; Wu, Y.C.L.; Crawford, L.W.; Loeffler, N.; Muehlhauser, J.W.; Martin, J.F.; Smith, R.H. (Tennessee Univ., Tullahoma (USA). Space Inst.). 11 Jul 1975. Contract E(49-18)-1760. 99p. Dep. NTIS $5.45.

8878 (ERDA-tr—102-P2) **U-25 MHD Pilot Plant. Part II. MHD generator studies.** Sep 1974. Translation of Russian report. vp. Dep. NTIS $7.60.

Topics include the development of an MHD generator channel and the study of its operation; experimental research on plasma conductivity and electrode/current leakage in the U-25 channel; a theoretical model of the plasma flow in the channel of an MHD generator and its application to the analysis of the experimental data obtained on the U-25 facility; high temperature materials for the MHD generator; and investigations of the invertor system as a segmented MHD generator load. (WHK)

8879 (ERDA-tr—102-P3) **U-25 MHD Pilot Plant. Part III. Major components and the long-duration R-channel.** 1975. Translation of Russian report. vp. Dep. NTIS $7.60.

The results of research and development conducted during the shakedown tests of the U-25 facility which involved upgrading of the various components are summarized. The oxygen supply system, regenerative air preheaters, seed injection and recovery, the steam generator, the combustor, and the MHD generator "R" channel are discussed. (WHK)

8880 MHD power generation. Technology status and development plan. Jackson, W.D. pp 411-436 of In Clean fuels from coal. Chicago; Inst. of Gas Tech. (1975).

From Clean fuels from coal symposium II; Chicago, Illinois, USA (23 Jun 1975).

See CONF-7506102—.

Increasing attention is now being focused on magnetohydrodynamic (MHD) power generation as a promising means for converting ample domestic coals to clean electricity. Significant data from engineering experiments indicate that MHD generators in combined MHD--steam cycle systems can achieve overall efficiencies 50 to 60 per cent higher than contemporary steam plants while simultaneously permitting environmentally compatible combustion of dirty fuels. This paper reviews the status of MHD technology development and discusses current technology development requirements. Illustrated are several U.S. and foreign MHD test facilities and some results of tests on key components. International development efforts, for both closed and open cycle MHD generators, are also reviewed and areas of cooperation discussed. The paper closes with presentation of a national plan for commercial development of MHD as initiated by ERDA and EPRI (Electric Power Research Institute) for joint governmental--industrial participation. (auth)

8881 Open-cycle MHD power generation: status and engineering development approach. Jackson, W.D. (Energy Research and Development, Washington, DC); Zygielbaum, P.S. *Proc. Am. Power Conf.*; 37: 1058-1071(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The Electric Power Research Institute (EPRI) has been working with the Fossil Energy Office of the Energy Research and Development Administration (ERDA-Fossil Energy) for the past year on long-range planning for MHD power generation. The current work, issues, and problem areas, some significant criteria, and the overall aspects of the EPRI-ERDA planning activities are reviewed. (WHK)

MATERIALS, COMPONENTS, AND AUXILIARIES

8882 (ORNL—5046, pp 72-74) **Developments in alpha spectrometry with liquid scintillators.** Thorngate, J.H.; McDowell, W.J.; Perdue, P.T.; Christian, D.J. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Liquid organic scintillators, combined with solvent extraction techniques, provide a sensitive means to measure small amounts of alpha-emitting heavy metals. Moreover, pulse-shape discrimination procedures can reduce the background from pulses produced in the scintillator by electrons to below 0.01 count/min. Recently, an effort was conducted to optimize both the detection system and the solvent extraction process. The scope of the program was limited to bone and tissue samples, because the Medical Physics and Internal Dosimetry Section of the Health Physics Division was interested in measuring plutonium in such samples. Progress is reported. (WHK)

DUCT ENGINEERING AND FLUID DYNAMICS

8883 (NP—20826) **Non-equilibrium phenomena in a disc-shaped magnetohydrodynamic generator.** Veefkind, A. (Technische Hogeschool Eindhoven (Netherlands)). Mar 1970. 103p. Dep. NTIS (US Sales Only) $5.50.

The work presented describes the non-equilibrium phenomena of a medium flowing through a magnetohydrodynamic generator, especially when a disc-shaped Hall generator is involved. A set of basic equations is composed of conservation equations obtained from Boltzmann's equation, and of simplified Maxwell's equations. The basic equations describe the behavior of the electron density, the neutral density, the electron velocity, the

velocity of ions and neutrals, the electron temperature, the temperature of ions and neutrals, and the electric field, throughout the generator. One-dimensional and stationary solutions demonstrate the development of electron temperature elevation and non-equilibrium ionisation. Also starting from the basic equations, and using first-order perturbation theory, critical Hall parameters are derived at which ionisation instabilities begin to develop. A pulsed experiment is carried out in a disc-shaped channel, using pure argon as a medium, at pressures of about 10 Torr and temperatures of about 5000°K. Various diagnostic methods are applied, viz. high-speed photography, electrostatic probes, spectroscopy, a piezo-electric crystal, and microwave techniques. Thus, information has been obtained on the electron temperature, the electron density, the neutral density, the flow velocity, and the electrical potential of the plasma. Clear evidence of electron temperature elevation has been found, whereas no non-equilibrium ionisation has been measured. A considerable influence of ionisation instabilities on the Hall electric field is measured. The experimental results are discussed and compared with the theoretical predictions.

EHD GENERATORS

REFER ALSO TO CITATION(S) 9609

THERMOELECTRIC GENERATORS

DESIGN AND DEVELOPMENT

8884 Monocrystalline anisotropic thermoelement having shorted emf vector in the direction coincident with that of the thermal flux. Anatychuk, L.I.; Dimitraschuk, V.T.; Luste, O.Y. US Patent 3,920,480. 18 Nov 1975. Filed date 4 Dec 1973. 8p.

A thermoelement is described comprising a monocrystal possessing different electric conduction coefficients along at least two principal crystallographic axes, wherein a thermoelectromotive force appears under the effect of the thermal flux therethrough, and at least one shorting member electrically connecting at least two points on said monocrystal, which lie opposite to each other on the outer surface thereof and in the plane passing through said two principal crystallographic axes, so that the straight line interconnecting these points forms an angle other than 0° and 90° with one of said principal crystallographic axes. Said member is designed to short the thermoelectromotive force component the direction whereof coincides with that of said thermal flux. The thermoelement also comprises leads to tap current from the monocrystal in a direction normal to said straight line interconnecting said two points on the monocrystal and in the plane passing through said two principal crystallographic axes. (auth)

THERMIONIC CONVERTERS

DESIGN AND DEVELOPMENT

8885 (COO—2263-4) **Advanced thermionic energy conversion. Progress report, September 1, 1974—August 31, 1975.** (Rasor Associates, Inc., Sunnyvale, Calif. (USA)). 1975. Contract E(11-1)-2263. 173p. Dep. NTIS $6.75.

During this reporting period the characteristics of several types of advanced thermionic energy converters were explored, both analytically and experimentally. Two new converter test vehicles were developed and two test stands and a controlled-atmosphere converter processing station were completed for use in the experimental program. Our previous understanding of pulsed converters was confirmed experimentally, and the work of earlier investigators concerning the inert gas ignited triode was substantiated. However, the experimental performances of the cesium vapor ignited and unignited triode converters were found to be significantly less than expected. More detailed analysis of their basic operation has revealed previously unsuspected constraints on the plasma in these advanced modes of operation. Based on both analysis and experimental results, the ignited triode was selected as the most attractive mode of converter operation for more intensive future study. A "mini-system", combining a thermionic diode operating in air and a flux-reset circuit, was constructed to demonstrate that inductive output coupling could be used effectively. A variety of thermionic heat exchanger concepts was evaluated, and cylindrical geometry was selected as the reference design concept. System analysis showed this design should be economically attractive for topping central station electricpower plants if 2nd generation performance can be obtained and if the structural, heat transfer, and output power coupling assumptions can be reduced to engineering practice. (auth)

FUEL CELLS

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 8725

8886 Electric utility fuel cell: dream or reality. Fickett, A.P. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.;* **37**: 1072-1081(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The status of the development of fuel cells for electric utilities is reviewed, and an economic comparison of fuel cell power plants to other generator options is given graphically. Research programs are summarized. (WHK)

8887 Electrochemical cell comprising a catalytic electrode of a refractory oxide and a carbonaceous pyropolymer. Hausler, R.H. (to Universal Oil Products Co.). US Patent 3,881,957. 6 May 1975. Filed date 2 Jul 1973. 12p.

An electrochemical cell having a catalytic electrode which is comprised of a refractory oxide having a surface area from 1 to 500 square meters per gram, and a carbonaceous pyropolymer forming at least a monolayer of said refractory oxide is described. The electrode has a conductivity at room temperature of from 10^{-8} to 10^{0} inverse ohm-centimeters. (auth)

8888 Method of operating a fuel cell using sulfide fuel. Zito, R. Jr.; Kunz, L.J. Jr. (to General Engineering Labs., Inc.). US Patent 3,920,474. 18 Nov 1975. Filed date 25 May 1972. 12p.

A fuel cell with all-liquid feed and effluent is made feasible through the use of fuels comprising a liquid source of sulfide ion. The fuel cell comprises anolyte and catholyte compartments, and anode and cathode electrodes. The compartments are separated by an ion-transfer or mechanically porous membrane or the like. Gas producing reactions are suppressed through competing liquid product reactions. (auth)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 8747

8889 Gas diffusion electrode for electrochemical cells. Boehm, H.; Heffler, J. (to Licentia Patent-Verwaltungs GmbH). US Patent 3,871,922. 18 Mar 1975. Priority date 12 Jul 1971, German, Federal Republic of (F.R. Germany). 6p.

A gas diffusion electrode for an electrochemical cell having an acidic electrolyte is discussed. It includes a metal net; a corrosion-resistant, electrolyte- and gas-impervious, graphite-foam coating on the net; sunken canals on the graphite-foam coating for conducting electrolyte; a porous catalyzing layer conforming with the net and in contact with the graphite-foam coating; and an electrically insulating coating on the graphite-foam coating. (auth)

PHOTOVOLTAIC CONVERTERS

REFER ALSO TO CITATION(S) 8376

POWER CYCLES

OTHER

8890 Banks engine. Banks, R. (Univ. of California, Berkeley). *Naturwissenschaften;* **62**: 305-308(1975).

A novel heat engine utilizing macroscopic shape changes associated with a thermally-activated phase transformation in alloys of nickel and titanium has been demonstrated. Engines capable of converting small temperature differences at near-ambient temperature to mechanical work are seen as a promising technology for the recovery of thermal energy currently going to waste. Depending on future economic feasibility, such engines may be practically applied to conversion of solar, geothermal, oceanic thermal gradient or industrial thermal sources. (auth)

SUPERCONDUCTING GENERATORS

REFER ALSO TO CITATION(S) 9213, 9215

SUPERCONDUCTING MOTORS

REFER ALSO TO CITATION(S) 9215

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 8767, 8768, 8772, 8774, 8784, 8808, 8873, 8875, 8876

BUILDINGS

REFER ALSO TO CITATION(S) 8384, 8386, 8782, 8847

8891 (ANCR—1276) **Space heating systems in the Northwest: energy usage and cost analysis.** Keller, J.G.; Kunze, J.F. (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1976. Contract E(10-1)-1375. 46p. Dep. NTIS $5.50.

The question of energy usage and cost of providing space heat in the Northwest is discussed. Though space heating needs represents only 18% of the U.S.'s total energy consumption, it nevertheless appears to offer the greatest potential for conservation and near term applications of alternate energy sources. Efficiency and economic feasibility factors are considered in providing for space heating demands. These criteria are presented to establish energy usage, cost effectiveness and beneficial conservation practices for space heating of residential, commercial, and industrial buildings. Four Northwestern cities have been chosen whose wide range of climate conditions are used to formulate the seasonal fuel and capital cost and hence the annual heating cost covering a broad spectrum of heating applications, both the traditional methods, the newer alternate forms of energy, and various methods to achieve more efficient utilization of all types.

RESIDENTIAL

8892 (ORNL/TM—5146) **Regional comparison of savings from various residential energy conservation strategies.** Delene, J.G.; Gaston, J.B. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 69p. Dep. NTIS $6.00.

The energy use and cost of providing space conditioning to a reference model home in various cities in the United States were calculated for alternate space conditioning systems and for various residential energy conservation strategies. The benefits and costs of increasing the thermal insulation in new and in older homes were estimated, as well as the value of the revised HUD minimum insulation standards compared to their predecessor. The benefits of thermostat setback and improved gas furnance efficiency were estimated from both a resource savings and consumer economic standpoint. The economic analysis included capital and maintenance, as well as costs reflected in the consumer's utility bill. Heating systems considered include heat pump, electric furnace, gas and oil furnaces, and either electric baseboard or ceiling heat. This report is intended to provide basic data for future studies. Such studies include evaluations of the potential effect of energy saving strategies and future shifts in residential heating patterns. (auth)

OFFICE

REFER ALSO TO CITATION(S) 8770

AIR AND AEROSPACE

REFER ALSO TO CITATION(S) 8789, 8790

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 8771, 8898

PIPELINE

REFER ALSO TO CITATION(S) 8781, 8823

INDUSTRY

REFER ALSO TO CITATION(S) 8773, 8782, 8789, 8790, 8809, 8891

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 8769

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 8363

8893 (KFK—2200, pp 51-61) **Closed cycles for energy and raw materials engineering.** Schulten, R. Apr 1975. (In German). In Contributions to nuclear engineering.

ELECTRIC POWER

REFER ALSO TO CITATION(S) 8785

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 8351, 8363, 8366, 8371, 8372

8894 (COM—75-10359) **Problems and potentials of recycling wastes for aquaculture.** Kildow, J.; Huguenin, J.E. (Massachusetts Inst. of Tech., Cambridge (USA). Sea Grant Project Office). 30 Dec 1974. 178p. (MITSG—74-27). NTIS $7.00.

The potentialities and problems of using thermal effluents and/or secondary sewage as inputs to a marine aquaculture system is the main focus of this study. The demand on coastal zones for both waste disposal and food production is complimented by the rising feed cost for raising fish and farm animals. In examining the advantages of a waste-food recycle system current and foreseeable problems, especially including those dealing with biological, social, political and legal matters become more recognizable and obtainable in deriving solutions. Economic planning, institutions of concern, consumer acceptance of waste-grown seafoods and marketing strategies are discussed. The state-of-the-art and potential development involving the use of thermal effluents in marine aquaculture, include the problems of thermal waste, aquaculture potential, and technical, biological and chemical problems. The use of domestic sewage and metal contamination are also major factors. (GRA)

8895 (PB—240300) **Physical-chemical treatment at elevated temperatures.** Wright, N.W. (Arizona Univ., Tucson (USA). Dept. of Civil Engineering and Engineering Mechanics). 1974. Contract DI-14-31-0001-3803. 76p. NTIS $4.75.

Thesis.

The effect of operating temperature on the physical-chemical treatment of domestic wastewater, using ferric chloride and powdered activated carbon, at temperatures between 24°C (75°F) and 74°C (165°F) was explored. A single step operation that combined chemical clarification and adsorption of dissolved organic material was used and the effect of temperature on the following parameters was observed: Turbidity, COD (total and soluble), residual phosphate, pH and sludge characteristics. The results showed that optimum operating temperatures do exist for individual parameters observed, and that increased operating temprature was not beneficial to all parameters. Iron concentration was shown to have an important effect on optimum operating temperature. The purpose of this research was to find out if the treatment process would work at a high temperature. If so, the sewage effluent during treatment could be used as cooling water for power plants. (GRA)

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

SPARK-IGNITION

REFER ALSO TO CITATION(S) 8900, 8901, 8904

8896 (SAND—75-8697) **Hot-wire measurements of the turbulence structure in a motored spark-ignition engine.** Witze, P.O. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 19p. (CONF-760102—3). Dep. NTIS $3.50.

From 14. AIAA aerospace sciences meeting; Washington, District of Columbia, USA (26 Jan 1976).

Statistical techniques were developed for the processing of hot-wire anemometer signals digitally recorded in a motored Otto-cycle engine. Since engine flow processes are highly non-stationary, it is necessary to use ensemble-averaging procedures to define both the mean flow properties and turbulence structure. Statistical definitions and experimental results are presented for the mean velocity, turbulence intensity, skewness, kurtosis, probability density distribution, autocorrelation function, one-dimensional energy spectrum, and the micro- and integral-scales of turbulence. It is shown that these turbulence quantities are statistically well-behaved, such that an understanding and the eventual modeling of engine flow processes would appear to be an achievable goal. (auth)

ROTARY

REFER ALSO TO CITATION(S) 8899

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 8755, 8764, 8805, 8871

8897 (KFK—1793) **Possibilities of energy recuperation by gravity traction in public transit systems.** Jung, V. (Kernforschungszentrum Karlsruhe (F.R. Germany)). Dec 1975. 50p. (In German). Dep. NTIS (US Sales Only) $4.00.

70 or 80 percent of the traction energy employed in the operation of metropolitan and suburban railways on lines with the stops arranged at short intervals are used for the kinetic energy of the vehicles. If at all, this energy is recuperated only at a rate of approximately 30 percent. Gravity traction allows the kinetic energy of the vehicles to be recuperated at a rate of about 90 percent during deceleration, which would decrease the overall energy input by 63 to 72 percent. However, this requires the line to be arranged uphill and downhill, and a traction system not based on the interaction of forces between a wheel and a rail (e.g., linear induction motors) might be needed. In addition, it may be possible, by means of gravity traction, to attain high acceleration levels wich will not be felt by the passengers and will not be detrimental to cargo. The result would be high average speeds, even at short intervals between stops, without requiring more traction power, and perhaps without the need for active traction (passive vehicle). A relationship is established between the parameters of the trackway and the change of the vertical and horizontal acceleration values as a function of time. The sea sickness range and excessively high changes in acceleration as a function of time can be excluded by the proper choice of the trackway parameters. (auth)

VEHICLE DESIGN FACTORS

ENGINE SYSTEM

REFER ALSO TO CITATION(S) 8907

8898 (BERC/RI—76/1) **Investigation of the fuel economy potential of three late-model automobiles.** Fleming, R.D.; Campbell, A.D. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Feb 1976. 21p. Dep. NTIS $3.50.

Modern automobile engines and associated emission controls are undergoing many design changes to improve fuel economy while meeting the required emission standards. For improved assessment of tradeoff options involving fuel economy, emissions, and performance, it is important to establish as a baseline the fuel-economy potential of modern engines when the constraint of emission controls is removed. This report describes the results of experimental work to determine the fuel-economy potential of three late-model automobiles and then to quantify the fuel-economy differential brought about by imposing emission controls to meet the current emission standards. The emission-control systems that were used included both oxidation catalysts with exhaust-gas-recirculation (EGR) and manifold air-injection systems with EGR. Results of tests with a 350 cubic-inch-displacement (CID) Chevrolet, a 318-CID Plymouth, and a 351-CID Ford indicate that an 11- to 40-pct improvement in fuel economy can be achieved if constraints upon engine parametric adjustment are removed. The precise value depends upon the type of emission-control system and/or driving cycle. The values suggest the lower boundary of potential improvement for these engines given an emission requirement and control system fully compatible with best fuel economy. Results on fuel economy, vehicle performance, and emissions from chassis dynamometer and road tests are discussed in the report.

8899 **Ignition system for rotary internal combustion engines.** Munden, C.D. (to General Motors Corp.). US Patent 3,919,994. 18 Nov 1975. Filed date 11 Nov 1974. 18p.

An electronic ignition system and ignition coil is provided for each the leading and trailing spark plugs of a rotary internal combustion engine. A series of alternating current signals, produced in timed relationship with the engine, are applied simultaneously to the leading spark plug ignition system and a delay circuit. In response to each cycle of the series of alternating current signals, the leading spark plug ignition system establishes and abruptly interrupts the primary winding of the leading spark plug ignition coil and the delay circuit produces both a synchronizing signal having leading and trailing edges corresponding to the negative to positive and positive to negative zero crossover points, respectively, and a trailing spark plug ignition signal delayed in time from the positive to negative zero crossover point. Logic circuitry responsive to the leading edge of the synchronizing signal and the trailing spark plug ignition signal produces a trailing spark plug ignition system dwell signal of a pulse width equal to the time therebetween which is applied to the input circuit of the trailing spark plug electronic ignition system. (auth)

8900 **Internal combustion engine with auxiliary chamber having variable size openings.** Yagi, S.; Inoue, K. (to Honda Giken Kogyo Kabushiki Kaisha). US Patent 3,919,984. 18 Nov 1975. Filed date 23 Jan 1974. 6p.

A three-valve spark-ignition internal combustion piston engine has an auxiliary combustion chamber connected to each main combustion chamber through a torch nozzle. The intake valve for the auxiliary chamber is provided with a skirt for varying the effective size of the torch nozzle under controlled turning movement of the intake valve stem. The effective size of a restricted opening which connects the auxiliary chamber to an adjacent chamber containing the spark plug electrodes is also changed by means of a skirt on the auxiliary intake valve. (auth)

8901 **Variable size torch nozzle for internal combustion engine.** Yagi, S.; Sato, Y.; Miyaki, K. (to Honda Giken Kogyo Kabushiki Kaisha). US Patent 3,919,985. 18 Nov 1975. Priority date 14 Feb 1973, Japan. 4p.

A three-valve spark-ignition internal combustion piston engine has an auxiliary chamber connected to each main combustion chamber through a torch nozzle. The intake valve for the auxiliary chamber is provided with an apertured skirt for varying the effective size of the torch nozzle under turning movement of the intake valve stem, controlled by intake vacuum pressure of the engine. (auth)

8902 **Output controlling method and device for internal combustion engines.** Goto, K. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 3,919,986. 18 Nov 1975. Priority date 9 Jul 1973, Japan. 4p.

A description is given of a method of and a device for controlling the output of an internal combustion engine. A mixture in an amount corresponding to the amount corresponding to the amount required for the full load operation of the engine is caused to flow into each cylinder in the suction stroke, even in the case of partial load operation. In the compression stroke, the amount of mixture required for the particular load of the engine remains in the cylinder, while the rest flows back into the suction system from the cylinder. (auth)

8903 **Induction systems for internal combustion engines.** Bun, C.C. US Patent 3,919,988. 18 Nov 1975. Priority date 9 Jan 1970, United Kingdom of Great Britain and Northern Ireland (UK). 10p.

In an internal combustion engine, air and/or steam is drawn into the induction manifold of the engine through at least one tube provided with a flow restrictor. The tube is made of copper and passes through the exhaust manifold, so that it becomes heated to a high temperature, causing oxidation of the copper and induction of copper oxide particles into the induction manifold. (auth)

8904 Internal combustion engine coordinated dual action inductive discharge spark ignition system. Neuman, J.G. (to General Motors Corp.). US Patent 3,919,993. 18 Nov 1975. Filed date 10 Jul 1974. 20p.

A coordinated dual action inductive discharge spark ignition system for use in an internal combustion engine is described. The system is composed of an inductive discharge circuit to produce a high arc-creating voltage and another operated in slaved relationship to the first to produce a high arc current. The system accomodates itself to the rapid change from very high resistance across the sparking electrodes, immediately prior to ignition arc creation, to the very low effective resistance after the arc is struck by shifting automatically from the high voltage system as the source of arcing current to the high current system. The ignition coil of the high current system is designed with a comparatively small number of low resistnace secondary turns, so that the internal resistance of the high current system is low when viewed from the arcing terminals and is very much less than that of the high voltage system. (auth)

EMISSION CONTROL

REFER ALSO TO CITATION(S) 8898, 8903

8905 Catalyst converter. Gandhi, H.S.; Heintz, W.K.; Shelef, M. (to Ford Motor Co.). US Patent 3,920,404. 18 Nov 1975. Filed date 11 Sep 1974. 6p.

A description is given of a catalytic converter employing a radial flow catalyst substrate. First and second enclosing can sections define an interior volume sufficiently large to have the radial flow catalyst substrate supported inside. Structure is provided for blocking one end of the radial flow catalyst substrate and additional structure is provided for mounting the blocking structure in contact with one end of the catalyst substrate. Support and sealing structures are provided at opposite ends of the enclosed catalyst substrate in order to resiliently cushion the substrate. The structure permits exhaust gases to flow into the interior volume of the catalyst substrate, radially through the substrate and then out to an exhaust pipe. The substrate has catalytically active material for eliminating undesirable components of the gas stream passing through the converter. (auth)

8906 Controller for proportional control of reducing converter air. Bolton, R.A. (to General Motors Corp.). US Patent 3,919,842. 18 Nov 1975. Filed date 31 May 1974. 8p.

A controller in the exhaust emission control system for the engine of an automotive vehicle controls secondary airflow between a region ahead of a reducing converter and a region between the reducing converter and an oxidizing converter. The amount of air introduced ahead of the reducing converter is proportional to engine exhaust flow and is preferably introduced closely adjacent to the exhaust ports of the engine. The controller, adapted to be connected to a source of secondary air, includes a fixed area bleed orifice which controls airflow to a region ahead of the reducing converter and a fluid pressure actuated valve which controls airflow to the region intermediate to the reducing converter and the oxidizing converter. (auth)

8907 Method and apparatus repetitively controlling the compositon of exhaust emissions from internal combustion engines, in predetermined intervals. Wahl, J.; Schmidt, P.J.; Zechnall, R. (to Robert Bosch GmbH). US Patent 3,919,983. 18 Nov 1975. Priority date 14 Sep 1972, German, Federal Republic of (F.R. Germany). 10p.

Certain intervals are determined in which output signals from an exhaust gas sensing device are sensed, and then applied to a control circuit, to control the fuel supply system (carburetor, or fuel injection system) in such a direction that a predetermined ratio of fuel and air is being supplied to the engine to provide exhaust gases of predetermined composition. The intervals are determined by a logic circuit which monitors engine operating parameters such as operating time of the engine after having been started, engine speed, engine power condition (idling, or supplying power), engine temperature, or the like. (auth)

8908 Exhaust gas purification system. Nohira, H. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 3,921,396. 25 Nov 1975. Priority date 20 Nov 1973, Japan. 8p.

A description is given of a secondary air supply control system for internal combustion engine exhaust gas purification systems. A change-over valve selectively supplies secondary air from the air pump either to the upstream side of the catalytic converter or to a second change-over valve, and an on-off valve and control valve controls the switching. The second change-over valve supplies the secondary air from the first change-over valve to the exhaust ports of the engine for discharging into the atmosphere, and a second valve controls the switching action. Part of the secondary air from the air pump is supplied to the downstream side of the catalytic converter. (auth)

8909 Engine exhaust gas purifying means. Kawata, M. (to Toyo Kogyo Co., Ltd.). US Patent 3,921,395. 25 Nov 1975. Priority date 24 Oct 1973, Japan. 8p.

The design of a thermal reactor is given. The device includes an outer shell and inner shell which are axially aligned cylinders. One element has a closed end and an open end, the second has opposite open ends, an inlet pipe being provided on each inner shell element and extending radially through and secured to the outer shell. The outer shell is provided with an outlet at an end adjacent to the first inner shell element. (auth)

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 8764

8910 (CONF-7509105—1) **Methanol/gasoline blends as automotive fuel.** Allsup, J.R. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). 1975. 9p. Dep. NTIS $3.50.

From Society of Automotive Engineers Off-Highway Vehicle meeting; Milwaukee, Wisconsin, United States of America "USA" (8 Sep 1975).

Ten 1974 and 1975 model vehicles were tested to determine the effect on exhaust emissions and fuel economy of methanol added to gasoline. Ambient temperature was varied from 20° to 100°F to determine temperature effects while using methanol/gasoline blends. Emissions were generally modified because the addition of methanol to gasoline alters both the fuel vapor pressure and the stoichiometry of the air-fuel mixture. Fuel economy was generally decreased by methanol addition. Moderate mileage accumulation using 10 percent methanol fuel showed no deterioration either in emissions control or of fuel-related engine components. (auth)

8911 (TEC—75/004) **Automotive storage of hydrogen as a mixture of methanol and water. Final report.** Kester, F.L.; Konopka, A.J.; Camara, E. (Institute of Gas Technology, Chicago, Ill. (USA)). Nov 1975. 70p. Dep. NTIS $5.00.

The concept of steam-reforming methanol on-board an automobile was evaluated as a candidate method of storing fuel for the hydrogen engine. This method uses low-temperature, engine waste heat to evaporate a 1:1 molar water-methanol mixture at 373°K (212°F) and to provide endothermic reaction heat at 505°K (450°F) to convert this mixture to hydrogen and carbon dioxide. By using engine waste heat, a fuel combustion enrichment of 8% (LHV) or 18% (HHV) is obtained when the reactor effluents are compared with those from the tanked fuel. Defining system efficiency as the product of the generator chemical efficiency (108%) and the engine thermal efficiency (assumed to be 30%) yields a value of 32.4%. Conservative estimates indicate that an additional volume of 44 to 49 liters and an additional weight of 110 to 140 kg would be required, compared with a conventional 20 gal gasoline tank. A 500 hour endurance test of this system with a Girdler G-66B catalyst was conducted at 505°K (450°F), atmospheric pressure, and low space velocity--compared with automotive requirements--at wide-open-throttle conditions with laboratory-grade methanol; there was no loss of activity. However, when fuel-grade methanol containing small amounts of higher alcohols was substituted for the laboratory-grade methanol, significant catalyst deactivation occurred. (auth)

8912 (TEC—75/005) **Hydrogen-fueled internal combustion engine, a technical survey of contemporary U.S. projects. ETA report PR-51.** Escher, W.J.D. (Escher Technology Associates, St. Johns, Mich. (USA)). Sep 1975. 122p. Dep. NTIS $5.45.

A special survey of contemporary U.S. hydrogen-fueled internal combustion engine research activities was conducted. The results, which considerably expand the previously available technical information baseline, are presented. Fourteen hydrogen engine research groups, with a wide range of backgrounds and organizational makeup, were found to have conducted experimental work of significance over the past five years. Some 49 hydrogen-air and hydrogen-oxygen internal combustion engines of both the piston

and rotary combustion types are included in the resulting survey. Several of the organizations (over half) developed demonstration hydrogen-fueled vehicles; 15 of these were documented as well. Onboard hydrogen storage systems of the pressurized gas, cryogenic liquid, and metal hydride types were successfully employed. A wide range of technical options were explored in the various research engines, especially in the technique and equipment employed in hydrogen admission to the engines. The hydrogen engine's propensity for producing relatively high amounts of oxides of nitrogen (NO/sub x/) emissions when operated at high power settings was noted and, in the case of several of the projects, accurately quantified. (auth)

MATERIALS

8913 (UCID—16977) **Classification of x-ray powder diffraction patterns using pattern recognition.** Chappell, G.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Aug 1975. Contract W-7405-Eng-48. 27p. Dep. NTIS $4.00.

The feature selection and classification techniques of pattern recognition were applied to a selected set of x-ray powder diffraction spectra. The final analysis involved using both $\sin^2\theta$'s and related intensities, to form the pattern space. Further work should involve determination of the significance of features selected and their relationship to atomic structure, as well as expansion of the training set and the number of classes considered. (auth)

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 9023

8914 (UCRL—51947) **Chemical and statistical analysis of an inventory of precious metal in the LLL Metal Finishing Shop.** Harrar, J.E.; Waggoner, M.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Contract W-7405-Eng-48. 51p. Dep. NTIS $5.45.

Results of a physical and chemical inventory of the quantities of gold and silver on hand at the LLL Metal Finishing Shop were analyzed by the statistical procedures used in nuclear materials control. Sources of error were identified, the magnitudes of systematic and random errors were calculated, and the data were combined to find the variance and confidence intervals of the estimated, mean quantities of precious metals. Comparisons were made between the techniques of controlled-potential coulometry and atomic-absorption spectrophotometry for the analysis of the electroplating baths, and a study was made of the effects of analyzing unstirred baths. (auth)

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 8741, 9020

8915 (CNLM—3087) **CNLM—3087, November 4, 1960 (report).** (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 4 Nov 1960. 6p. Dep. NTIS $3.50.

Declassified 12 Jan 1976.

A proposal is presented concerning design of a very compact NaK-to-air radiator matrix design using heat resisting alloys, for inclusion in an engine of small diameter for use in aircraft with low frontal area requirements. The design of compact high performance liquid metal-to-air radiators demands the incorporation of superior extended surfaces to increase the heat transfer capabilities of a unit volume of the matrix. A design concept being studied incorporates large flattened tubes to form each liquid metal pass in the radiator. Continuous ribbon extended surfaces are to be brazed or welded to the flattened tubes to yield a high density matrix. (auth)

8916 (IS—3623) **Calculations concerning precipitate growth during impact extrusion.** Scott, T.E. (Ames Lab., Iowa (USA)). Dec 1975. Contract W-7405-eng-82. 39p. Dep. NTIS $4.00.

An analysis of carbide particle growth during impact extrusion of 440A stainless steel was made and it was concluded that diffusion enhancements of the order of 8000 or more would be needed to produce particles with 25 A radii under such conditions. Deformation-induced excess vacancy enhanced diffusion was examined for the conditions of impact extrusion and it was learned that significant diffusion enhancement would not occur by this mechanism. Finally, dislocation "pipe" diffusion as a possible diffusion enhancement mechanism was evaluated. Although it would appear that "pipe" diffusion is capable of providing large enhancements, the experimental results were contradictory to the behavior predicted by the "pipe" diffusion model. The overall conclusion is that carbide particles cannot grow to physically meaningful sizes during impact extrusion. (auth)

8917 (LBL—4273) **Origin and control of the dominant impurities in high-purity germanium.** Haller, E.E.; Hansen, W.L.; Hubbard, G.S.; Goulding, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-eng-48. 20p. (CONF-751116—21). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

Techniques have been developed to consistently purify germanium to the 10^{10} atoms/cm^3 range. The major impurities are the acceptors boron and aluminum and the donor phosphorous. Formation of non-segregating compounds of boron and aluminum make these elements difficult to remove by conventional zone refining whereas phosphorous and all other electrically-active impurities segregate normally and are therefore removed in the zone refining process. The only significant impurity introduced in our Czochralski crystal puller is phosphorous whose source has been traced to the quartz crucible. To reliably reduce impurity concentrations to acceptable levels it has been necessary to develop techniques for determining the types and concentrations of impurities in both the final single crystals and in the polycrystalline zone-refined ingots and to relate these results to the use of various boat and crucible materials. Photothermal ionization spectroscopy and electrical measurements have been used to identify and measure the impurities. (auth)

8918 (NLCO—1128) **Ferrous and common nonferrous metals industries and associated scrap metals: a review.** Mautz, E.W. (comp.). (National Lead Co. of Ohio, Cincinnati (USA)). Nov 1975. Contract E(30-1)-1156. 67p. Dep. NTIS $4.50.

Literature on the common metals industries, scrap metal relationships, and transportation aspects has been reviewed as background information in a study to determine the feasibility of a portable melting facility for radioactively contaminated metals. This report draws substantially on government-sponsored studies. Aluminum, copper, iron and steel, and nickel metal industries are discussed from the viewpoints of the general industry characteristics, primary metal production processes, and secondary metal processing aspects. 46 references, 10 tables. (auth)

8919 (ORNL-TM—5194) **Deposition profiles from electron-beam-heated evaporation sources.** Reiley, T.C. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 16p. Dep. NTIS $4.50.

The thickness of physically vapor deposited copper and chromium specimens was measured as a function of position on a flat substrate situated above an electron-beam-heated evaporation source. The resulting profiles deviated from analytically predicted profiles based on the integrated mass flux from a flat surface of infinitesimal, directed surface sources. This deviation has been noted in the past and has been attributed to molecular interaction above the source. However, it is shown that the calculated molecular mean free path is much too long to allow any appreciable interaction of the evaporating molecules. Further, curvature of the molten source, arising from the surface recoil from evaporating molecules, is likely to be responsible for the difference between the observed and predicted profiles. (auth)

8920 (UCRL—77850) **Diamond polishing a diamond turned x-ray microscope.** Baker, P.C.; Brown, N.J.; Saito, T.T.; Randall, W.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1975. Contract W-7405-Eng-48. 6p. (CONF-760219—1). Dep. NTIS $3.50.

From Workshop on optical fabrication and testing; San Mateo, California, United States of America "USA" (27 Feb 1976).

Polishing with diamond powders has produced exceptionally smooth surfaces on nickel and copper. Surface roughness measurements and contour analysis are included.

8921 **Manual sample grinder/polisher.** Hoffman, C.G. (Los Alamos Scientific Lab., NM). pp 357-361 of In Microstructural science. Vol. 3. French, P.M. (ed.). New York; American Elsevier Publishing Co., Inc. (1975).

A new hand grinding tool for grinding metallographic samples is described. It is inexpensive, capable of producing a high degree of flatness as well as permitting a fast operation. It requires very little training and skill and consequenty is suitable for use by new technicians while producing surfaces of such quality and so rapidly that experienced metallographers will like and use it. (auth)

8922 Preparation of high T/sub c/ Nb_3Ge superconductors by chemical vapor deposition. Newkirk, L.R.; Valencia, F.A.; Wallace, T.C. (Los Alamos Scientific Lab., NM). pp 704-712 of In Chemical vapor deposition. Blocher, J.M. Jr.; Hintermann, H.E.; Hall, L.H. (eds.). Princeton, NJ; The Electrochemical Society, Inc. (1975).

From 5. international conference on chemistry vapor deposition; Burkinghamshire, UK (21 Sep 1975).

See CONF-750991—.

Bulk layers of Nb_3Ge were deposited on copper substrates at 900°C by hydrogen reduction of the chlorides of niobium and germanium with resistive T/sub c/'s as high as 22.5°K and current densities up to 1.8×10^6 amp-cm^{-2} at 13.8°K. The paper provides a detailed description of the coating process as well as empirical correlations between deposition parameters and T/sub c/. Quantitative chlorination of Nb was found to be possible at T ≈ 250°C and for T > 900°C extending the range of delivery rates below those obtainable by powder feeding of $NbCl_5$. Coatings in the range of 10-60μm thick have been produced with a typical deposition efficiency of 50-65 percent for mass flow rates of the order of 1 g of salt per minute. The superconducting transition temperature was correlated with a parameter of the form mole ratio x dilution x Reynolds number /sup 0.22/, where mole ratio is defined by moles Nb:moles (Ge + 0) in the gas stream, and dilution by moles gas: moles salt. In addition, the relationship between mole ratio and dilution which determines the phase produced (Nb_3Ge_a) is defined over the region of major interest. Lattice spacings are presented over a range of t/sub c/'s, and microstructure and substrate adherence are discussed. (auth)

8923 High-rate sputtering of Nb—Al—Ge and Nb—Al superconductors. Dahlgren, S.D. (Battelle Pacific Labs., Richland, WA). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 217-220(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

High quality Nb—Al—Ge and Nb—Al superconductor deposits, up to 1 mm thick, were made at a rate of 1 μm/min using high-rate sputtering techniques. High-rate sputtering eliminates most of the fabrication problems generally encountered with these materials. Reasonable quantities of high-field superconductors can be made at acceptable cost for practical applications by high-rate sputtering. Highly reflective metallic mirror surfaces on these deposits indicate a high quality, even in thicknesses up to 1 mm. The deposits were completely free of voids and they did not seem to be overly brittle either before or after heat treatment. Crystal structures for deposits made at 20°C were probably bcc. Heat treatment between 550 and 850°C completely transformed the bcc deposits to extremely small (350 A) grains of the A-15 crystal structure. The A-15 phase formed by heat treatment for 1 h to 5 days at 750°C was metastable and supersaturated with Al and Ge. Deposition and heat conditions for decomposition of the metastable A-15 phase were identified. The highest critical temperatures (18°K) were observed only in those deposits containing undecomposed metastable A-15 phase. To assess practical use of the sputtered superconductors, 1- to 2-m lengths of ribbon and filamentary Nb—Al—Ge superconductor were produced on ribbon and wire substrates. It also was found that an excellent superconductor-stabilizer bond can be formed by high-rate sputter deposition of copper stabilizer onto heat-treated Nb—Al—Ge and Nb—Al superconductors. (auth)

8924 Fabrication and properties of Nb_3Sn superconductors by the solid diffusion process. Suenaga, M.; Sampson, W.B.; Klamut, C.J. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 231-237(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

It has been demonstrated that the superconducting compound Nb_3Sn can be produced at the interface of Nb and a Cu—Sn alloy when the composite is heat treated at the proper reaction temperature. This method of Nb_3Sn preparation was also shown to be particularly suited to the fabrication of (a) Nb_3Sn multifilamentary composite wires for dc and low frequency applications and (b) low ac loss Nb_3Sn tapes for 60 Hz applications. The fabrication method and superconducting properties of Nb_3Sn composite conductors made by this process are reviewed and the metallurgical aspects of the process are discussed. Since practical applications of these composites requires large, high current conductors, methods of producing compound conductors such as cables and braided ribbons which include strengthening and stabilizing components are also discussed and some preliminary results of high current conductors are presented. (auth)

8925 Solid solutions of niobium—tin for preparing Nb_3Sn superconductors. Galligan, J.M.; Tregilgas, J. (Univ. of Connecticut, Storrs). Contract AT(11-1)-2305. *IEEE Trans. Magn.*; **MAG-11**: No. 2, 238-239(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Solid solution alloys of niobium with concentrations of Sn from 1 to 9 wt percent were prepared by quenching the solid solution from about 2100°C to room temperature. These materials are relatively ductile and can be deformed, by swaging, into the desired shape, after which the material is reacted at about 800°C. The resulting structure is a mixture of Nb_3Sn and Nb, with as much as 45 percent of the volume containing Nb_3Sn. (auth)

8926 High strength diffusion welding of silver coated base metals. O'Brien, M.; Rice, C.R.; Olson, D.L. (Rockwell International, Rocky Flats, CO). *Weld. J. (N.Y.)*; **55**: No. 1, 25-27(Jan 1976).

Al, Be, maraging steels, and a variety of dissimilar alloys were bonded using Ag as an intermediate layer. Effects of diffusion welding parameters on the Ag solid state joint were studied on maraging steel. Tensile strengths as high as 97 ksi were achieved with electrodeposited Ag surfaces. (DLC)

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 9030, 9183, 10026, 10027, 10028

8927 (COO—2679-3) **Voids, dislocation loops and grain boundaries as sinks for point defects.** Balluffi, R.W. (Cornell Univ., Ithaca, N.Y. (USA)). Oct 1975. 26p. Dep. NTIS $4.00.

A review is presented on present knowledge of the manner in which voids, dislocation loops and grain boundaries act as sinks for point defects. A discussion is given of idealized atomistic models for the sink action. The overall problem of the kinetics of defect annealing to sinks is also considered. A discussion is given of additional complications which include the effects of sink stresses on the defect diffusion to sinks and the enrichment, or depletion, of solute atoms at sinks by the defect currents. An abbreviated review of experimental observations is included, and an attempt is made to summarize briefly the state of the field. (auth)

8928 (ORO—4311-4) **Quantitative analysis of solute segregation in alloys by transmission electron microscopy. Progress report, September 1, 1974—December 31, 1975.** Hren, J.J.; Hartley, C.S. (Florida Univ., Gainesville (USA)). Dec 1975. Contract AT(40-1)-4311. 12p. Dep. NTIS $3.50.

Progress is reported on image simulation and experimental TEM studies of linear and planar defects. A previously developed program for linear defects has been modified to include certain modifications to the geometry of the TEM specimen. This will be useful for comparing results with other techniques such as field ion microscopy (FIM). A program for simulation of 3D defects such as dislocation loops, stacking fault tetrahedra and voids is currently being written. Experimental studies on planar defects in steam-oxidized Si show that these defects are probably stacking faults with solute atoms segregated to them. (auth)

8929 (UCRL-Trans—10758) **Quantitative evaluation of ultrasonic backscattering measurements in metals.** Koppelmann, J.; Fay, B. Translated from *Acustica;* **29**: 297-302(1973). 17p. Dep. NTIS $3.50.

Measurements of ultrasonic backscatter have the advantage that sound attenuation measurements can be carried out on a side of a polycrystalline test specimen which has no plane-parallel surfaces. A formula is obtained for quantitative evaluation of the backscatter measurements and the accuracy of the formula is illustrated by means of some sample measurements. The accuracy obtained in the measurement shows that this method of measurement is comparable with the classical multiple echo method. (auth)

8930 (UCRL-Trans—10975) **Metallugical study of electron-beam welding of the alloy U—0.2% V.** Prunier, C.; Linard, M.; Guillaumin, J.; Giraud-Heraud, F. Translated from *Mem. Sci. Rev. Metall.*; **71**: No. 7/8, 461-473(1974). 27p. Dep. NTIS $5.00.

The effects of welding cycles on U—0.2 percent V alloys involving cooling at high rates from the β and γ phases were studied. The results indicate that the welding operation modifies the initial structure obtained by the heat treatment to refine the α grain. The weld is decomposed into three primary zones of different metallurgical nature with respect to the particular thermal cycles. Beta-hardenings are characterized by a single β yields α transformation range. In contrast, depending on the cooling law, γ-hardenings are manifested by one or more transformation anomalies which lead to complex α structures, one of which has a maximum hardness and a minimum ductility. (auth)

8931 Relationship between atomic ordering and fracture in Fe—Al alloys. Marcinkowski, M.J. (Univ. of Maryland, College Park); Taylor, M.E.; Kayser, F.X. *J. Mater. Sci.;* **10**: 406-414(1975).

The fracture surfaces of slowly cooled Fe—Al alloys containing up to 28 at. percent Al were examined using scanning electron microscopy techniques. It was found that the fracture modes changed from void coalescence to transgranular and finally, to intergranular as the Al concentration increased. The latter two modes of fracture were of the brittle type and were associated with the onset of long range order in these alloys. In particular, it has been postulated that atomic ordering leads to markedly reduced cross-slip, in turn reducing the degree to which void coalescence, with accompanying ductility, can occur. (auth)

8932 Ordering temperature for $Cu_{79}Au_{21}$. Brophy, J.W.; Kayser, F.X. (Ames Lab., IA). *Phys. Status Solidi (a);* **30**: K33-K36(1975).

The ordering temperature of a 79.1 at. percent Cu—20.9 at. percent Au alloy was studied by measuring the room temperature lattice parameters of samples that had been rapidly quenched from various annealing temperatures. Results are analyzed and presented in tables and plots. (JRD)

8933 New rapid and accurate method to measure low-energy-electron-diffraction beam intensities: the intensities from the clean Pt (111) crystal face. Stair, P.C.; Kaminska, T.J.; Kesmodel, L.L.; Somojai, G.A. (Univ. of California, Berkeley). *Phys. Rev., B;* **11**: No. 2, 623-629(15 Jan 1975).

The intensities of the low-energy-electron-diffraction beams backscattered from the clean platinum (111) surface are measured by a photographic technique. The fluorescent screen in a conventional low-energy-electron-diffraction chamber is photographed at various incident electron energies in electron-volt intervals in the range of 20 to 200 eV. The film is then machine developed and scanned using a computer-controlled digital-output microdensitometer. The intensity profiles of all of the diffraction beams can be obtained simultaneously this way in ten minutes and these are identical to those measured by telephotometer. The film can readily monitor three orders of magnitude change in intensity. The photographic diffraction-beam-intensity measurement is particularly useful when time-dependent changes in the beam intensities due to adsorption, chemical reactions or electron-beam-surface interactions occur or when many diffraction beams are present as in the case of coincidence lattices or reconstructed surfaces. The diffraction beams from the clean platinum (111) crystal face have been measured by both photography and telephotometry and the intensity profiles necessary to carry out surface-structure analysis are reported. (auth)

8934 Structure determination of the platinum (111) crystal face by low-energy-electron diffraction. Kesmodel, L.L.; Somorjai, G.A. (Univ. of California, Berkeley). *Phys. Rev., B;* **11**: No. 2, 630-637(15 Jan 1975).

An analysis of low-energy-electron-diffraction intensity profiles from the clean (111) face of platinum is carried out. Calculated intensities are compared with experimental results for specular and nonspecular beams at several angles of incidence for electron energies less than or equal to 100 eV. The calculations are based on a T-matrix multiple-scattering theory with corrections for lattice vibrations. The scattering from a single atomic site is modeled with a conventional band-structure potential parametrized by six partial-wave phase shifts. The constant inner potential V_0 determined from addition of the Fermi energy and a measured value of the work function is found to predict the peak positions accurately. The calculations adequately describe the shapes and relative intensities of primary and secondary features in the experimental intensity profiles. Analysis of the data indicates that the spacing of the topmost atomic layer is the same as the bulk value to within 5% (or approximately 0.1 A). (auth)

8935 Interpolated band-structure models and integration schemes. Cooke, J.F.; Davis, H.L.; Mostoller, M. (Oak Ridge National Lab., TN). *Phys. Rev., B;* **11**: No. 2, 706-709(15 Jan 1975).

A method of calculating Brillouin-zone integrals is proposed, which is based on the use of model-Hamiltonian interpolation schemes to generate energy bands and the Hellman-Feynman theorem to generate energy gradients. Since the method does not make use of quadratic interpolation, a direct comparison can be made between the results of electronic density of states calculations done with and without the use of quadratic interpolation. An illustrative comparison between the two types of calculations is presented for the case of niobium. (auth)

8936 Positive-ion-induced Kossel lines in copper. Roberto, J.B. (Cornell Univ., Ithaca, NY); Appleton, B.R.; Batterman, B.W.; Kostroun, V.O. . *J. Appl. Phys.;* **46**: No. 2, 936-937(Feb 1975).

Proton beams have been used to generate Kossel lines in single crystals of copper by the excitation of characteristic radiation at atomic sites inside the crystals. The observed lines exhibit a fine structure similar to lines previously generated using incident electrons and x rays. A key advantage of the positive-ion technique is that the bremsstrahlung background associated with the electron generation of Kossel lines is eliminated. The possible application of the positive-ion technique to impurity lattice location is discussed. (auth)

8937 Exact results for a three-dimensional alloy with site diagonal disorder: comparison with the coherent potential approximation. Alben, R. (Yale Univ., New Haven, Connecticut); Blume, M.; Krakauer, H.; Schwartz, L. *Phys. Rev., B;* **12**: No. 10, 4090-4094(15 Nov 1975).

Densities of states and spectral functions are obtained for large (~ 8000 atoms) three-dimensional alloy models with cell localized disorder and are compared with the single-site coherent-potential approximation (CPA). The CPA agrees well with the exact numerical results. In particular, the overall structure of the electronic spectrum and the transition from one- to two-band behavior are well described. There is, however, some substructure which is not reproduced by the single-site approximation. (auth)

8938 Self-consistent pseudopotential calculations for Si (111) and reconstructed (2X1) model structures surfaces: unreconstructed (1X1) . Schlueter, M.; Chelikowsky, J.R.; Louie, S.G.; Cohen, M.L. (Univ. of California, Berkeley). *Phys. Rev., B;* **12**: No. 10, 4200-4214(15 Nov 1975).

A recently developed method involving self-consistent pseudopotentials has been used to calculate the electronic structure of several Si(111) surface models. The results for (1 X 1) unreconstructed, relaxed and unrelaxed surfaces are compared with earlier calculations and discussed in terms of density-of-states curves and charge-density distributions. A fully self-consisent calculation has been carried out for Haneman's (2 X 1) reconstructed surface model. It is found that the important experimental results can be understood using this model, and changes in the electronic structure occurring after reconstruction are rationalized on chemical grounds. In particular infrared-absorption measurements, photoemission measurements, and recent angular-dependent photoemission measurements find consistent explanations. (auth)

8939 de Haas-van Alphen effect study of dislocations in copper. Chang, Y.K.; Higgins, R.J. (Univ. of Oregon, Eugene). *Phys. Rev., B;* **12**: No. 10, 4261-4281(15 Nov 1975).

The influence of lattice dislocations on conduction electrons has been studied both theoretically and experimentally in copper single crystals. A first-principles de Haas-van Alphen (dHvA) dephasing calculation was made, using the dislocation strain field with a realistic dislocation array. Both the Dingle temperature X, which characterizes the amplitude reduction, and the dHvA relative phase shift were measured using dHvA wave-shape analysis. Breaking the cubic symmetry by introducting a forest of edge dislocations allows a test of the sensitivity of previously equivalent neck orbits to the relative orientation with respect to the dislocation lines. Both magnitude and anisotropy agree with the theory. Orbits in contact with the Brillouin zone were found to have larger X. A slight field dependence predicted by the dephasing calculation was observed. The large discrepancy observed among different 1/tau results obtained from dHvA, radio-frequency size effect, and resistivity measurements is due to the different sensitivity of each method to small-angle scattering by the long-range strain field around dislocations. It is shown how to separate dislocation effects from mosaic-structure effects also present in these strained crystals. (auth)

8940 Surface-electronic-structure information from bulk plasmon photoexcitation in free-electron metal films. Feibelman, P.J. (Sandia Labs., Albuquerque, NM). *Phys. Rev., B;* **12**: No. 10, 4282-4301(15 Nov 1975).

Bulk-plasmon-photoexcitation (BPPE) phenomena (particularly the shapes of resonance peaks associated with standing-plasma-wave excitation) in thin free-electron-metal films are shown to be sensitive to surface electronic structure. A formalism is developed which permits the microscopic evaluation of corrections to the classical theory of the optical properties of a jellium solid, through first order in the wave vector of an incident electromagnetic wave. This formalism permits the evaluation of effects due to BPPE in both the ordinarty optical as well as in the photoemissive properties of thin films, and moreover, allows one to determine their dependence on the forms of the one-electron surface potential barriers V(z) at the two film surfaces. Theoretical results based on the random phase approximation (RPA) to a jellium film's dielectric response are compared to the photoyield data of Anderegg et al. taken on potassium films. The experimental BPPE resonance features are found to be considerably narrower

than the theory predicts--for all the forms of V(z) that were tried--casting some doubt on the RPA's ability to describe surface dielectric phenomena quantitatively. The asymmetry of Anderegg et al.'s films, i.e., the fact that their upper and lower film surfaces were inequivalent, is shown to require a partial reinterpretation of their data; in particular, their films were probably only about half as thick as they supposed.Moreover, the argument that leads to this conclusion also provides a simple explanation for the alternation of BPPE resonance peak strengths which appears to be a fairly systematic feature of their data. Directions for further experimental and theoretical work on BPPE phenomena are suggested. (auth)

8941 Photoemission spectroscopy using synchrotron radiation. II. The electronic structure of germanium. Grobman, W.D.; Eastman, D.E.; Freeouf, J.L. (IBM Thomas, J. Watson Research Center, Yorktown Heights, NY). *Phys. Rev., B;* **12**: No. 10, 4405-4433(15 Nov 1975).

Photoemission spectra are analyzed for Ge obtained for photon energies 6.5 less than or equal to hv less than or equal to 25 eV and determine the position of energy bands at symmetry points for both filled and empty bands within 1 Ry of the gap. This experimental band structure is obtained using a recently developed anisotropic direct-transition model of photoemission applicable to cleaved single-crystal semiconductors. For the band-structure determination a direct transition analysis of optical spectra obtained by others is used. Nonlocal-pseudopotential calculations are fitted to the experimentally-determined band positions, and thereby determine the importance of both energy and l = 2, angular momentum nonlocality in the pseudopotential. Results for the position of high-lying conduction-band states suggest 0 to +10 percent self-energy (exchange-correlation) corrections to the energy of electrons excited into the conduction bands. Energy bands which provide a good fit to the experimental band positions are used, along with pseudo-wave-function matrix elements, to calculate various physical properties (photoemission spectra, optical-response functions, and one-electron state densities), and the results of these calculations are compared with experiment. The quality of the fits obtained indicates that the electronic excited-state (and ground-state) properties of Ge for excitations far from the gap are described well by a one-electron model. (auth)

8942 Density of electronic energy levels in disordered systems. Friedberg, R. (Barnard Coll., New York); Luttinger, J.M. *Phys. Rev., B;* **12**: No. 10, 4460-4486(15 Nov 1975).

The behavior of the density of electronic energy levels for a simple model of a disordered system is studied in the limit of very low energies. By reformulating the problem as one in Brownian motion, it proves possible to obtain the leading term and the first correction to it. The leading term is just the one already conjectured by Lifshitz. (auth)

8943 Effects of solution and intermediate heat treatments on the notch-rupture behavior of Inconel 718. Muller, J.F.; Donachie, M.J. Jr. (Los Alamos Scientific Lab., NM). *Metall. Trans., A;* **6A**: No. 12, 2221-2227(Dec 1975).

The effects of solution and intermediate heat treatments on the notch stress-rupture properties of Inconel 718 were investigated using commercial quality barstock. It was determined that a solution heat treatment of 1038°C for as short a time as 20 min could render this alloy notch-sensitive by solutioning extensive quantities of the orthorhombic Ni_3Nb delta phase. Restoration of notch ductility subsequent to 1038°C (20 min) solution heat treatment was accomplished by the insertion of a 917°C (10 h) intermediate heat treatment, prior to aging, during which significant quantities of the delta phase were precipitated. This intermediate heat treatment was not successful in restoring notch ductility to specimens which had been given longer, 1 h, solution heat treatments at 1038°C. A 954°C (3 h) intermediate heat treatment was also not successful in restoring notch ductility to specimens solution heat treated for 20 min at 1038°C. It was confirmed that the most important factors controlling the notch-rupture ductility in Inconel 718 are the size, quantity, and distribution of the delta phase. The grain size of the material did not directly control the notch properties. (auth)

8944 Phase transitions and modulated structures in ordered $(Cu-Mn)_3Al$ alloys. Bouchard, M.; Thomas, G. (Univ., of California, Berkeley). *Acta Metall.;* **23**: No. 12, 1485-1500(Dec 1975).

Quenched and aged alloys along the composition line Cu_3Al—Cu_2MnAl have been studied by electron diffraction and microscopy. Quenching produces an ordered solid solution based on the DO_3 structure of Cu_3Al and the $L2_1$ structure of Cu_2MnAl. Below 350°C the alloys decompose inside a miscibility gap into a Cu_2MnAl-rich phase and a Cu_3Al-rich phase. The resulting microstructures possess all the metallographic characteristics of spinodal decomposition. In the Al-rich asymmetrical alloy, the Cu_2MnAl-rich phase heterogenously nucleates at $^1/_4a(111)$APB's. In the symmetrical alloy, the structure of the Cu_3Al-rich particles varies with the decomposition temperature. At temperatures close to the miscibility gap, the structure of the particles is DO_3. These DO_3 particles are further modulated by a dense array of small regions having the LI_0 superstructure and exhibit tweed strain contrast. At lower temperatures, the particles are composed of a regular arrangement of twelve possible variants of the LI_0 phase. At all temperatures, the structure of the CU_2MnAl-rich phase is $L2_1$. During overaging of the symmetrical alloy at temperatures close to the miscibility gap, the Cu_3Al-rich phase transforms to the γ phase having a composition near Cu_9Al_4. Thus it is suggested that for the symmetrical alloy the decomposition tie line is close to Cu_9Al_4—C $u_{2\cdot2}MnAlb0._8$ (LK)

8945 Electronically driven lattice instabilities. Sinha, S.K.; Harmon, B.N. (Solid State Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **35**: No. 22, 1515-1518(1 Dec 1975).

A general and physically simple model based on rigorous formulations of the dielectric function is presented and used to explain the phonon anomalies in niobium and niobium carbide. The model contains the explicit q dependence of both the electron-phonon and electron-electron interactions for localized states near the Fermi energy and appears quite useful for explaining the q dependence of phonon anomalies and lattice instabilities in various systems. (AIP)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 8635, 8679, 8681, 9020, 9045, 9265

8946 (AERE-R—7165) Introduction to Weibull statistics. Braiden, P.M. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Dec 1975. 21p. Dep. NTIS (US Sales Only) $3.50. UK pounds1.00.

This report describes Weibull statistics with particular reference to the analysis of data obtained from mechanical tests on brittle materials. The basic equations are all derived from first principles and the construction and use of Weibull Probability Graphs are described in detail. Finally some typical strength tests are analyzed and compared from a statistical approach. (auth)

8947 (COO—1676-38) Effect of anodic oxide films on low temperature mechanical behavior of niobium single crystals. Sethi, V.K.; Gibala, R. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Metallurgy and Materials Science). 31 Oct 1975. Contract AT(11-1)-1676. 10p. (CONF-750999—1). Dep. NTIS $3.50.

From Meeting on surface effects in crystal plasticity; Hohegeiss, F.R. Germany (5 Sep 1975).

The effect of thin (less than or equal to 1500 A) anodic oxide films on the mechanical behavior of single crystals of niobium at low temperatures (T less than or equal to 0.15 T/sub M/) was investigated. Oxide films affect mechanical behavior in two ways: the yield stress is reduced and the stress-strain curves are serrated over an appreciable range of strains. When oxide-coated specimens are also prestrained into stage I at 300°K, the serrations observed at low temperatures disappear, the flow stress is further reduced, the ductility is increased, and a three-stage work hardening behavior occurs. A model involving generation and motion of nonscrew dislocations from the oxide-metal interface is used to explain the results. (auth)

8948 (COO—2422-04) Materials and mechanics of rate effects in brittle fracture. Progress report, October 1974—October 1975. Burns, S.J. (Rochester Univ., N.Y. (USA)). 1975. Contract E(11-1)-2422. 8p. Dep. NTIS $3.50.

The critical stress intensity factors for propagating cracks, K/sub ID/, was experimentally found to decrease with increasing crack velocity. K/sub ID/ was measured using rapidly wedged double cantilevered beam specimens. The crack length versus time was continuously recorded using electro-potential techniques. The specimens were fractured at temperatures well below the brittle to ductile transition temperature. The crack velocity in these specimens varies continuously but is typically in the range of 100 to 200 m/s. The analysis of fully dynamic crack propagation in double torsional beam specimens was solved in closed analytic form. The solutions for rotational rate loading and for constant applied torque, predict constant crack velocity. The crack velocity is given by the applied rate of rotation, the magnitude of the applied torque and specifics about the beam. The maximum crack velocity is the torsional wave speed. The use of the analysis is to deduce K/sub ID/ during crack propagation without measuring the crack velocity directly. The measurements of static, dynamic loading and propagating crack, stress intensity factors establishes that rate is an

important variable in specifying the stress intensity factor for fracture. (auth)

8949 (COO—2733-2) **Creep analysis of structures using a new equation of state type constitutive relation.** Kumar, V.; Mukherjee, S. (Cornell Univ., Ithaca, N.Y. (USA)). Sep 1975. 40p. Dep. NTIS $4.00.

A computational scheme is presented for the analysis of a certain class of problems involving creep of metals at elevated temperatures. The high temperature nonelastic behavior of materials is assumed to obey a new mechanical equation of state type constitutive relation recently proposed by Hart. As an illustration, the problem of creep of a closed-ended thick-walled cylinder under internal and external pressures is analyzed employing the proposed computational scheme and Hart's equation of state approach. Results are compared qualitatively with the results of classical strain hardening and time hardening theories of creep and the experimental results obtained earlier by other researchers. The proposed computational scheme is found to be very efficient from the view point of both computational time and effort. In regard to the equation of state approach, it is found that in addition to the general features of these classical creep theories, it is also capable of taking into account the effect of prior deformation history on subsequent creep behavior by simply specifying the initial distribution of a single state variable called hardness. (auth)

8950 (LBL—3124) **Fracture toughness of high strength Fe—Ni—Ti alloys.** Francis, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1975. Contract W-7405-ENG-48. 124p. Dep. NTIS $9.25.

Thesis.

8951 (MLM—2277) **Internal friction in uranium.** Selle, J.E. (Mound Lab., Miamisburg, Ohio (USA)). 20 Nov 1975. Contract E-33-1-Gen-53. 27p. Dep. NTIS $4.00.

Results are presented of studies conducted to relate internal friction measurements in U to allotropic transformations. It was found that several internal friction peaks occur in α-uranium whose magnitude changed drastically after annealing in the β phase. All of the allotropic transformations in uranium are diffusional in nature under slow heating and cooling conditions. Creep at regions of high stress concentration appears to be responsible for high temperature internal friction in α-uranium. The activation energy for grain boundary relaxation in α-uranium was found to be 65.1 +- 4 kcal/mole. Impurity atoms interfere with the basic mechanism for grain boundary relaxation resulting in a distribution in activation energies. A considerable distribution in ln τ_0 was also found which is a measure of the distribution in local order and in the Debye frequency around a grain boundary. (auth)

8952 (NRL-Report—7936) **Effect of specimen thickness on fatigue crack-growth rate in 5Ni—Cr—Mo—V steel: comparison of heat-treated and stress-relieved specimens.** Sullivan, A.M.; Crooker, T.W. (Naval Research Lab., Washington, D.C. (USA)). 9 Dec 1975. 16p. Office of Naval Research, Arlington, VA.

Ship structural design now incorporates the weight-saving advantage of high-strength alloys by reducing the thickness requirements of load-bearing members. For fail-safe applications of thin-section material (less than 0.50 in.thick) in high-performance ship structures, quantitative information concerning the fatigue crack-growth rate (FCGR) in both ambient air and the marine environment is highly important. The diverse conclusions of presently available information concerning the effect of material thickness on FCGR provide little engineering guidance for the design of thin-section naval structures. Results of studies of FCGR on a 5Ni—Cr—Mo—V steel tested in three thicknesses indicate that internal residual stresses may have a retardation effect on FCGR in this material. When tested after stress relief, although crack growth is accelerated, it is essentially the same for all thicknesses. (auth)

8953 (ORNL-TM—4993) **Interim report on the continuous cycling elevated-temperature fatigue and subcritical crack growth behavior of 2 1/4 Cr—1 Mo steel.** Brinkman, C.R.; Booker, M.K.; Strizak, J.P.; Corwin, W.R.; Frazier, J.L.; Leitnaker, J.M. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 91p. AT.

Results are reported for load- and strain-controlled fatigue tests conducted from room temperature to 1000°F with comparisons of other data to 1100°F. Cyclic hardening and softening characteristics for several heats of $2^1/_4$ Cr—1 Mo steel in the isothermally annealed condition are discussed. The data measured in this effort are compared with data available from the literature, and from the compilations possible ASME design fatigue curves are prepared covering continuous high- and low-cycle behavior from room temperature to 1100°F. Equations for these design curves are given. Limited information concerning tensile behavior, metallographic examination, heat-to-heat variations, and strain aging effects are also given. Results of limited subcritical crack growth tests conducted to 1100°F (593°C) at several stress ratios and frequencies are reported. 51 figures, 30 tables. (auth)

8954 (ORNL-TM—5170) **Quarterly progress report on the heavy-section steel technology program for July—September 1975.** Whitman, G.D. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 89p. Dep. NTIS $6.50.

Activities in research programs are reported on pressure vessel fracture properties, effects of reactor coolant water on reactor vessel cracking, pressure vessel load testing, thermal shock, and reheat cracking. (JRD)

8955 (SAND—75-8301) **Comparison of 9Ni—4Co—0.20C steel and titanium alloy properties for weight-critical structural applications.** Dawson, D.B. (Sandia Labs., Livermore, Calif. (USA)). Jan 1976. Contract AT(29-1)-789. 52p. Dep. NTIS $4.50.

Titanium alloys are attractive in weight-critical applications requiring high strength, due to their high strength-to-density ratios when compared with steel and aluminum alloys. The mechanical properties of titanium alloys such as Ti—6Al—4V, Ti—6Al—6V—2Sn, Ti—6Al—2Sn—4Zr—6Mo, and several beta alloys are discussed and compared with 9Ni—4Co—0.20C steel. Data is presented for strength, fracture toughness, fatigue properties, stress corrosion cracking behavior, and corrosion resistance. The trade-off in strength vs. toughness, SCC resistance, and weldability of titanium alloys is discussed. Recommendations of specific titanium alloy systems for various required strength levels are made on the basis of these factors. (auth)

8956 (UCRL-Trans—10982) **Relation between crack orientation and K/sub IC/ in the aluminum alloy A-Z5GU. A microfractographic study.** Vigier, P. Translated from *Rev. Alum. Ses Appl.;* No. 417, 279-288(1973). 21p. Dep. NTIS $3.50.

The critical value of the stress intensity factor K/sub IC/ or fracture toughness was measured for an aluminum alloy A-Z5GU (6% Zn, 2.4% Mg, 1.5% Cu) in the hardened-and-tempered state for the six principal orientations that the crack can have relative to the direction of rolling. The corresponding fracture features were observed at various magnifications (optical microscopy, microfractography by transmission or scanning electron microscopy) and were interpreted by considering the alloy's microstructure: grains elongated by rolling, coarse intermetallic constituents (approximately 10 μ) in the boundaries, and very fine constituents (approximately 0.2 to 1 μ) in the matrix. Generally, the ductile fracture tends to be intergranular and is initiated on the coarse constituents. When the crack plane and rolling plane are parallel, the crack grows primarily by intergranular decohesion along the layers of constituents; K/sub IC/ is then rather low. When the crack plane is perpendicular to the rolling plane, i.e., to the layers of constituents, the fracture surface is observed to be very irregular. As a result, there are abrupt steps perpendicular to the mean fracture plane. Although some grains can thus be circumvented by the crack, others are broken through the middle. In these transgranular ductile fracture zones closely spaced dimples initiated on the small constituentsincluded in the matrix are observed. The value of K/sub IC/ measured under these conditions is higher. (auth)

8957 **Solute effects on the dislocation damping behavior of Cu-based alloys.** Banerji, S.K.; Bilello, J.C. (State Univ. of New York, Stony Brook). pp 221-230 of In Internal friction and ultrasonic attenuation in crystalline solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From Conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F.R. Germany (27 Aug 1973).

See CONF-730844—P2.

The dislocation damping phenomena in single crystals of copper and copper-nickel solid solution alloys have been studied through high frequency ultrasonic attenuation experiments. Attention is focused on the solute effects and the influence of dislocation multiplication on the dynamics of dislocation motion in solid solution alloys. Quantitative characterization of the microstructure by etch-pitting technique has been correlated with the attenuation characteristics and micromechanical parameters in these alloys to gain more insight into the nature of dislocation interactions with random localized obstacle fields.

8958 (UCRL-Trans—10977) **Study of the forgeability and deformation resistance of the alloy U—0.2% V by torsion tests between 400 and 800°C.** Choquet, P.; Prunier, C. Translated from *J. Nucl. Mater.;* **57**: 34-44(1975). 27p. Dep. NTIS $5.00.

The resistance to deformation and the deformation capacity of the alloy U 0.2 wt. percent V between 400 and 800°C for deformation rates between 10^{-2} s^{-1} and 3.6 s^{-1} were studied by hot torsion. In this temperature range, the alloy exhibits three distinct

phases in succession: orthorhombic α, tetragonal β, and body-centered cubic γ, which behave differently. Two useful ranges were determined for the plastic working of the alloy U 0.2 wt. percent V: the α phase above 600°C and the γ phase. By the theory of plasticity the equivalence between the hot-torsion results and hot-tension results was established and a first rolling pass was simulated. Tensile tests between 600 and 800°C and a rolling test at 600°C demonstrated the justification for the transition between torsion and other modes of deformation. A micrographic study of the structure of test pieces after fracture showed the existence of recrystallization in the α phase beginning at 600°C and in the γ phase, which explains the good workability observed. (auth)

8959 Properties of noncoaxial passing dislocation loops. Sadananda, K.; Marcinkowski, M.J. (Univ. of Maryland, College Park). *J. Appl. Phys.*; **46**: No. 1, 18-26(Jan 1975).

Equilibrium configurations of single dislocation loops, as well as those of noncoaxial passing dislocation loops, have been determined by means of numerical techniques and by approximating the loops in terms of piecewise segments. Among other things, it is found that the passing behavior of the loops depends on the relative magnitudes of applied stress, dipole strength, and drag stress, where the dipole strength is the stress to break the dipole formed by the unlike segments of the two loops and the drag stress is the stress needed to generate a unit length of the dipole. For an applied stress greater than the dipole strength, the dislocation loops pass one another and their equilibrium shape is identical to that of a single dislocation loop. The passing behavior of the loops also depends on whether or not the loops are constrained by the presence of other neighboring dislocation loops that are usually present in a real crystal. For applied stresses less than the dipole stress, but greater than or equal to the drag stress, the constrained dislocation loops, in particular, form elongated loops with long screw dipoles. For the cases where the cross slip of screw segments is difficult, the results also show that screw dipoles are much more stable than edge dipoles and arises from the higher dipole strength and lower drag stress for screw dislocations as compared to the corresponding stresses for edge dislocations. (auth)

8960 Noncoaxial passing dislocation loops in ordered and disordered alloys. Sadananda, K.; Marcinkowski, M.J. (Univ. of Maryland, College Park). *J. Appl. Phys.*; **46**: No. 1, 27-35(Jan 1975).

A detailed analysis of single dislocation loops as well as of noncoaxial passing dislocation loops in ordered and disordered alloys has been made using the piecewise approximation. The analysis shows that the passing behavior of the loops depends on y, z, and γ, where y is related to the radius of the passing loops, z is the interplanar separation, while γ is the antiphase boundary energy. When y is less than some critical value, the results show that the superlattice dislocations in ordered alloys become unstable and dissociate into partial dislocations, the motion of which generates disorder in the crystal. With a decrease of γ, superlattice dislocation instability occurs at larger y. The sigificance of the above results in relation to the work hardening of ordered and disordered alloys is discussed in detail. (auth)

8961 Shock and release behavior in porous 1100 aluminum. Asay, J.R. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; **46**: No. 1, 197-203(Jan 1975).

Plate impact techniques were used to determine the dynamic response of 1.60-g/cm^3 porous aluminum at energy states approaching incipient melt. Both quartz gage and laser interferometric techniques were used to measure the shock response of this material over the stress range 0.6 to 7.3 GPa, which is in the region of full compaction. In addition, a nearly complete equilibrium release curve centered at 3.07 GPa was measured using reverberating wave techniques. This is thought to represent the first accurate measurement of a release isentrope through a fully compacted state of a distended material and allows a further test of the equation of state. It is found that both the initial compaction and the release behavior of the compacted aluminum can be accurately predicted using the Mie-Gruneisen equation of state. (auth)

8962 Annealing of deformed potassium. III. Length-change measurements. Gugan, D. (Wills Physics Lab., Bristol, Eng.). *Philos. Mag.*; **31**: No. 2, 453-463(Feb 1975).

Measurements of length-change have been used to study the recovery of high-purity potassium deformed by compression at 1.2°K. There is a large annealing band between 1.2 and about 20°K, the relative length-recovery rate being roughly constant at about 2 X 10^{-5} K^{-1}, the total length-increase being about 1 percent of the original plastic compression. The recovery spectrum is quite different from the 15°K point-defect stage observed in resistivity studies on cold-worked potassium. It is shown that the point-defect recovery stage is not affected by dislocation movement involved in the length recovery, which itself reflects a strong temperature dependence of internal stress due to thermal activation over some obstacle to dislocation motion, perhaps the Peierls-Nabarro stress. (auth)

8963 Dislocation model of a plastic tensile crack. Marcinkowski, M.J. (Univ. of Maryland, College Park). *J. Appl. Phys.*; **46**: No. 2, 496-505(Feb 1975).

An extensive numerical analysis has been made dealing with the energetics associated with the formation and propagation of plastic tensile and shear-type cracks. All of these cracks have been modeled entirely on the basis of dislocation theory. The most important finding of this investigation is that the stress required to propagate a plastic tensile crack is much higher than that for an elastic crack which in turn is greater than that for a plastic shear crack. (auth)

8964 Acoustic emission testing of unflawed 7075-T6 aluminum. Hamstad, M.A.; Mukherjee, A.K. (Univ. of California, Livermore). *J. Test. Eval.*; **3**: No. 3, 167-172(May 1975).

Tensile tests were performed to study the differences in the continuous acoustic emission from 7075-T6 aluminum plates made by five manufacturers. The grain structures and the chemical compositions of these plates were determined. Results are given on a sixth plate, which emitted burst-type acoustic emission superimposed on the continuous acoustic emission. The effect of orientation with respect to the rolling direction within a single plate was studied. Results from interrupted tensile tests are also reported; these tests were stopped at about 4.5 percent strain for different time periods before they were resumed. The tests indicate that acoustic emission is very sensitive to differences between plates of 7075-T6 aluminum that do not show up on a stress-strain curve. Furthermore, the dislocation mechanisms that cause the continuous acoustic emission in this aluminum alloy are altered by room temperature, diffusion-based aging. (auth)

8965 (SAND—75-6009) Influence of aggressive media on the mechanical behavior of the uranium—0.20 wt % vanadium alloy the role of hydrogen embrittlement. Arnould-Laurent, R. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Nov 1975. Translation of French thesis submitted to Paris Univ., Orsay, France. 169p. Dep. NTIS $6.75.

Thesis.

The tests comprised tensile tests under constant load or up to the fracture point using cylindrical or flat, trapezoidal test pieces, tests in which disks were ruptured under gaseous pressure, and tenacity tests. The alloy was found to be sensitive to: (1) intrinsic brittleness (I.B.) due to dissolved residual hydrogen from the preparation stage. This manifested itself mainly by cracking at an elongation threshold of about 3 percent. (2) Cracking due to stress corrosion (S.C.C.) in the true sense, which is made possible under certain conditions by an imperfect passivation of the metal surface. The process is initiated either by the appearance of microcracks which appear at the surface, or by corrosion pits. (3) Generalized corrosion accelerated by the stress (S.A.C.), whose microscopic appearance is similar to that observed with corrosion under gaseous hydrogen. Below pH 2 there is no stress corrosion. Stress rupture tests in moist air at 80 and 100°C measure I.B. + S.C.C. under high stress, giving rise to short lifetimes. I.B. + S.C.C. + S.A.C., with S.A.C. predominant, occurs under lower stresses that give long lifetimes. Stress rupture tests measure at 20 and 60°C I.B. + S.C.C. with I.B. predominant. Under high stresses (short lifetimes) the magnitude of the S.C.C. component increases as the temperature increases. The most serious effects are those of S.A.C. at 80 and 100°C, and of I.B. at all temperatures. The way this alloy behaves can only be changed by an effective reduction in the quantity of residual hydrogen present, or by coatings that will in no case allow the ingress of hydrogen. 62 fig, 82 references, 15 tables. (DLC)

8966 Pressure dependence of the yield stress of potassium at low homologous temperature. Chua, J.O.; Ruoff, A.L. (Cornell Univ., Ithaca, NY). *J. Appl. Phys.*; **46**: No. 11, 4659-4663(Nov 1975).

Tensile stress-strain curves for polycrystalline potassium were obtained at liquid-nitrogen temperature (T = 0.23 T/sub m/) and up to a pressure of 5.15 kbar. Pressure shifts the stress-strain curve upward. The yield stress versus pressure was measured. Theoretical dislocation models for the effect of pressure on the yield stress are reviewed herein. It is shown that the effect of pressure on the yield stress owes its origin to the effect of pressure on the effective elastic constant only. The present experimental results for the yield stress σ_0 as a function of pressure P are in excellent agreement with the equation $\sigma_0 = \sigma_{00}[1 + (C_0/\text{sup } e'/C_0)P]$, where σ_{00} is the yield stress at zero pressure, C_0/sup e/ is the value of the elastic constant C/sup e/ = G/(1 - ν) at zero pressure, and C_0/sup e'/ is the value of the pressure derivative of the elastic constant C/sup e/ at zero pressure. Here G is the bulk shear modulus and ν is Poisson's ratio. If C_0/sup e'/C_0 is replaced

by E'_o/E_o (where E is Young's modulus) or G'_o/G_o the agreement is also within experimental error. In this study, the yield stress was found to increase by 42 percent at 5.15 kbar. (auth)

8967 **Shock-compression and release behavior near melt states in aluminum.** Asay, J.R.; Hayes, D.B. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; 46: No. 11, 4789-4800(Nov 1975).

The response of porous aluminum (rho_o = 1.6 g/cm^3) when shock-compressed to states of partial melting and then released was investigated. There are no detectable changes in any of the Hugoniot properties in the region where melting should occur. However, release wave speeds in the completely compacted state of the porous aluminum specimens were found to depend critically upon the magnitude of the initial shock loading. For impact stresses below about 7 GPa, the measured release-wave velocity is well described by the assumption that the initial release is elastic. For initial impact stresses above 7 GPa, the speed of the release wave is observed to be about 20 percent lower than the elastic wave velocity and approaches the bulk sound speed predicted by equilibrium thermodynamics. All calculations of wave speeds were made with a complete equation of state which was obtained by constructiong semiempirical free-energy functions for both solid and liquid pure phases. These were developed by first assuming self-consistent forms for the second derivatives of the Helmholtz free energy and then adjusting coefficients in the second derivatives using known quasistatic thermodynamic properties for each phase until agreement with all available data was achieved. Calculation of the intersection of the Hugoniot with the melt boundary (7.5 GPa, 1340°K) using this equation of state when compared with the observed change in sound speed gives strong support to the assumption that melting occurred in these experiments. The release-wave technique shows promise for mesuring phase boundaries in regions of pressure and temperature not accessible by ordinary quasistatic techniques. (auth)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 8357, 8358, 8360, 8680, 9218, 9219, 9225, 9723, 10024, 10037, 10169

8968 (CEA-CONF—3095) **Application of the micro-calorimetry to the study of annealing and recrystallization phenomena during the sintering of metallic powders.** Cytermann, R.; Mazadier, M.; Auguin, B.; Defresne, A.; Gilles, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Chimie-Physique). 1975. 9p. (In French). INIS.

From Meeting on calorimetry and thermal analysis; Grenoble, France (22 May 1975).

Nickel powders compressed isostatically at pressures between 1 and 13 kbars were studied. The tests were all carried out under a current of hydrogen after vacuum degassing and at the same temperature increase rate. Cold-hardening of the powders was shown by the broadening of the x-ray diffraction lines. Microcalorimetry confirmed the separation of the compacting process into two stages: rearrangement with local deformation and bulk plastic deformation. (FR)

8969 (CONF-751209—6) **Magnetic studies of actinides: evidence for localized magnetism.** Lander, G.H. (Argonne National Lab., Ill. (USA)). 1975. 21p. Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The position of the 5f elements in the periodic table suggests that the electronic properties of these elements (and their compounds) will resemble those of the lanthanide series. However, the extended nature of the 5f wave functions leads to fundamental differences between 4f and 5f systems. Evidence for localized magnetism is reviewed. Results of magnetization, Moessbauer, neutron, and low-temperature x-ray experiments on Np, Pu, and Am compounds are used to illustrate both the similarities to and differences from lanthanide magnetism. A determination of the ground-state 5f electron wave functions is, in principle, possible by measuring the neutron magnetic cross section. The interpretation of such experiments on UO_2, USb, and PuP requires a knowledge of the radial extent of the 5f electrons, which is obtained from relativistic Dirac-Fock calculations, and the use of the tensor-operator formalism to treat the spin-orbit interaction. This interaction in Pu^{3+} (a $5f^5$ configuration) results in a magnetic form factor that initially increases with increasing scattering angle. For USb the experimental magnetic scattering is used to determine the ground-state wave function of the U^{3+} ion. In addition the temperature dependence of the quadrupole moment in USb has been measured and yields information both on the size of the crystal-field and exchange interactions, and on the interplay between them. (auth)

8970 (ERDA-tr—86) **Reports of the Nuclear Research Center, Karlsruhe. 7th annual publication.** (Kernforschungszentrum Karlsruhe (F.R. Germany)). Jan 1975. Translated from German report. 82p. Dep. NTIS $6.00.

Separate abstracts were prepared for each of the 8 papers included.

8971 (KFKI—75-61) **Ultrafast, single-exposure recording of domain wall motion in bubble films.** Zimmer, G.J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 22p. (CONF-750497—1). Dep. NTIS (US Sales Only) $4.25.

From International winter school on magnetic bubbles; Kocierz, Poland (Apr 1975).

The requirements of single-exposure recording of transient magnetization changes are reviewed. It is shown that both photoelectric and photographic techniques are feasible, with the latter being more flexible. High-speed conventional and Polaroid films are approximately equivalent. Only a few tens or hundreds of microjoules are required for exposure in less than 10 nanoseconds. The surface brightness limitation precludes the use of conventional light sources. A superradiant dye cell pumped by a flowing-nitrogen pulsed gas laser is used as a light source in the equipment described. Samples of domain-wall responses evoked by pulsed magnetic field are recorded on consecutive frames of 16-mm movie film. The motion is restored in the same way as the current pulse shape is restored on a sampling oscilloscope, which, in fact, provides most of the timing circuitry needed. The capabilities of the camera—microscope are illustrated by photographs of a dynamic diffuse domain boundary as well as of hard-to-soft bubble conversions. 9 figures, 2 tables. (auth)

8972 (LA—6146-MS) **Interaction between cesium and graphite for use in the study of surface phenomena.** Holian, B.L. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. 11p. Dep. NTIS $4.00.

Surface diffusion has been hypothesized as the fast mode of an unusual fast-slow, two-mode transport process that has been observed in recent diffusion experiments with cesium in graphite. An interaction potential between a cesium atom and a graphite surface is obtained in order to study this surface diffusion by computer simulation (molecular dynamics method). At low surface coverage, the interaction between cesium atoms can be ignored so that the motion of only one cesium atom need be followed, albeit in a very complicated potential energy surface. Cesium is spontaneously ionized by graphite, so that the interaction of cesium with the graphite surface contains pair-wise Cs^+ - C terms (valence, induction, and dispersion forces) as well as an image-charge model of the bulk electrostatic interaction. All parameters but the strength of the repulsive Cs^+ - C force are obtained by theoretical estimates, while this last parameter is determined by requiring that the adsorption Cs^+ - C bond length be the same as observed in cesium-graphite lamellar compounds. Results indicate that the adsorption energy for a pit in the graphite surface of one to five missing carbon atoms is not greatly increased over that for the perfect surface (the one-atom hole is slightly repulsive compared to the perfect surface). For the hexagonal six-atom pit, the adsorption energy increases dramatically from about 120 kcal/mole for the perfect surface to about 200 kcal/mole and remains essentially constant for larger holes. Results for potential energy barriers to migration indicate that a cesium ion on a perfect graphite surface moves along the surface like a free particle at temperatures above 1000°K. Thus, truly diffusive or random-walk behavior at such temperatures requires the presence of defects in the graphite surface. (auth)

8973 (LBL—4563) **Study of atomic scattering factors from the critical voltage of ordered alloys, application to Cu_3Au.** Rocher, A.; Sinclair, R.; Thomas, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-Eng-48. 4p. (CONF-750982—2). Dep. NTIS $3.50.

From 4. high voltage electron microscopy conference; Toulouse, France (1 Sep 1975).

The critical voltage (V/sub c/) effect, first discovered by Nagata and Fukuhara (1967) and Uyeda (1968), has already been used to determine experimental values of the Atomic Scattering Factor (ASF). The main interest of this study is to yield complementary information about ASF and Debye temperatures from data on an ordered alloy, Cu_3Au, using the technique developed by Rocher and Jouffrey (1972, 1974). For ordered alloys, reflections with low values of sin θ/λ are allowed, e.g., 100 and 110 are reflections of the Ll_2 structure of Cu_3Au, whereas the first reflection of the disordered fcc lattice is lll. The superlattice interaction potentials V_{100} and V_{110} also perturb dynamical effects such as critical voltage and it is then possible to determine their values as a function of V/sub c/. (auth)

8974 (SAND—75-5779) **Net anisotropy and ferromagnetic resonance frequency of an amorphous ferromagnet.** Richards, P.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 6p. (CONF-751209—1). Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The net anisotropy constants and the ferromagnetic resonance (FMR) frequency are calculated in a model of amorphous ferromagnetism for which the axes of strong local uniaxial anisotropy are nearly randomly oriented throughout the sample, and, consequently, the equilibrium directions of local magnetization are nonuniform. A slight preferential ordering produces net anisotropy perpendicular to the plane of a thin film sample as appropriate to sputtered Gd—Co films. The net anisotropy is a maximum for a given H/sub A/ near H/sub A/ H/sub E/ = 1.5, where H/sub A/ and H/sub E/ are the local anisotropy and exchange fields, and at H/sub A//H/sub E/ = 10 it is less than its value for H/sub A//H/sub E/ yields 0, corresponding to uniform magnetization. The FMR resonance frequency ω would contain a term of the order of H^2/sub A//H/sub E/, which can be comparable to the net anisotropy field (H/sub A/), if the magnetization were uniform, but this term cancels out if proper account is taken of the nonuniformity. As a result, ω is the same as would be computed for a uniform anisotropy field (H/sub A/). (auth)

8975 (RFP-Trans—180) **Adsorption behavior of oxygen and carbon dioxide on silver.** Ayame, A.; Ito, Y.; Kano, H.; Kanazuka, T. Translated from *Muroran Kogyo Daigaku Kenkyu Hokoku;* **8**: No. 1, 107-114(1973). 9p. Dep. NTIS $3.50.

Adsorption behaviors of oxygen and carbon dioxide on a silver catalyst in the oxidation of ethylene were studied by a pulse technique. Oxygen was adsorbed reversibly and irreversibly on the catalyst. The irreversibly adsorbed oxygen was familiar with the formation of carbon dioxide and water, and the existence of the reversibly adsorbed one promoted the formation of ethylene oxide. As, beyond 220°C, the amount of adsorbed oxygens is small and the oxidation of ethylene proceeds with higher conversions, the surface of silver catalyst during this reaction seems to be nearly the deoxygenated one. Carbon dioxide was adsorbed only on the oxygenated catalyst reversibly and irreversibly. The irreversibly adsorbed carbon dioxide seems to be remained on silver catalyst with the forming of silver carbonate as one of the catalyst-poison. The reversibly adsorbed one is estimated to retard the rates of the oxidation of ethylene. (auth)

8976 (UCRL-Trans—10735) **Theoretical calculation of the solubility of hydrogen in solid and liquid metals.** Filippov, E.S. Translated from *Izv. Vyssh. Uchebn. Zaved., Chern. Metall.;* No. 7, 122-128(1973). 13p. Dep. NTIS $4.00.

The solubility of H in solid and liquid metals was investigated in a wide range of temperatures, starting from first principles—lattice data (coordination number and atomic radii). The model of spheres of interaction was applied to the solubility of hydrogen by a method developed for the solubility of oxygen in equilibrium with a deoxidizing agent. In the polycrystalline representation of a liquid metal the sum of the solubilities in clusters (main volume) and in the disordered zone are considered. It is therefore easy to take ΔV/sub m.p./ as the part of the volume relating to the disordered zone (termed statistical packing (s.p.)), and V/sub s/ as the clusters. The results show that dissolution in s.p. microregions (if such exist) is difficult. Dissolution in vacancies and pores is not dissolution in microregions of the disordered zone, and the additional solubility increment associated with ΔV/sub m.p./ does not relate to a direct increase of the disordered zone or s.p. microregions. The property of grain boundaries to condense appreciable quantities of material cannot be extended to disordered microregions of the liquid. (auth)

8977 **Steady state technique for low temperature heat capacity of small samples.** Viswanathan, R. (Univ. of California, San Diego). pp 81-88 of In Analytical calorimetry. Volume 3. Porter, R.S. (ed.). New York; Plenum Press (1974).

From 3. analytical calorimetry symposium; Los Angeles, California, USA (30 Mar 1974).

See CONF-740315—.

Reported here is an elegant method based on steady state or ac calorimetry technique, using laser beam as heat source, to measure absolute heat capacity of tiny samples of mass 1 to 100 mgm. The results on high purity copper, gold, nickel and isotopes of molybdenum are given to show that the absolute accuracy of this method is ~ +-2 percent, at least comparable, if not better than conventional heat pulse techniques, which require bulky samples ~100 times larger. The possible variations of this method will also be discussed. (auth)

8978 **Relaxation and magnetic clusters in mictomagnetic copper—manganese alloys.** Mukhopadhyay, A.K.; Shull, R.D.; Beck, P.A. (Univ. of Illinois, Urbana). *J. Less-Common Met.;* **43**: No. 1/2, 69-82(1975).

Quantitative data were obtained on the average giant moment and the concentration of the magnetic clusters in Cu—Mn alloys. For aged $Cu_{75}Mn_{25}$ the magnitude of the giant moment is consistent with the size of the small, atomically-ordered regions, determined by Sato et al. by means of nuclear diffuse neutron scattering. Contrary to an early model, the results do not indicate that the concentration of giant moments is measurably affected either by cooling in a magnetic field or by isothermally increasing the applied magnetic field. The relaxation of the giant moments in the applied field is responsible for most of the alternating low field susceptibility at its peak and this relaxation also gives rise to the quasi-viscous time-dependence of the steady field magnetization in a certain temperature range below the peak. At very low temperatures, where the relaxation effects are frozen out, it is the quasi-elastic response of the giant moments that is responsible for the exceedingly high steady field susceptibility. (auth)

8979 (BNL-tr—618) **Pinning centers in polycrystalline Nb_3-SN films.** Bashkirov, Yu. A.; Vinogradov, V.M.; Darinskaya, E.V.; Kiseleva, K.V.; Kurganov, G.B.; Nikitina, G.T.; Rozhanskii, V.N. Translated by S.J. Amoretty from *Fiz. Met. Metalloved.;* **37**: No. 3, 517-524(1975). 18p. Dep. NTIS $4.50.

The possibility of increasing the critical current density in polycrystalline Nb_3Sn films by incorporation of defects and inhomogeneities was investigated. It was found that if the Nb_3Sn composition departs significantly from stoichiometry (approximately3 at. percent), it forms pinning centers because of the presence of the intrinsic defects (clustering of vacancies in the tin sublattice) of larger than optimum size. As a result, critical current densities of less than or equal to1.6×10^5 A/cm^2 are produced in a 40-kOe field. Removal of tin from the Nb_3Sn lattice by heat treatment initially increases the size of the intrinsic defects, followed by precipitation of crystals of the new nonsuperconducting phases serving as secondary pinning centers. Since precipitation occurs in the form of local clustering, the crystals rapidly increase in size, which decreases their importance as pinning centers while maintaining their low concentration. The critical current densities produced by the presence of these centers are less than or equal to2.5×10^5 A/cm^2 in a 40-kOe field. The importance of pinning in the intrinsic defects can be determined when polycrystalline Nb_3Sn films whose deviation from stoichiometry can be controlled in the entire range of the Nb_3Sn phase. (auth)

8980 (ERDA-tr—86, pp 32-39) **Critical current load capacity of NbTi superconductors and their angle dependence.** Juengst, K.P. (Institute for Experimental Nuclear Physics, Karlsruhe, Ger.). Jan 1975. Translated from German report.

In Reports of the Nuclear Research Center, Karlsruhe. 7th annual publication.

The fabrication and performance of superconducting NbTi wires are examined. Discussions are included on conductor construction, critical current relations with shielding currents, short volume pinning force, and critical current angle dependence. (JRD)

8981 (ERDA-tr—86, pp 49-57) **Highest grade aluminum as conducting material for cryomagnets.** Schauer, W. (Institute for Experimental Nuclear Physics, Karlsruhe, Ger.). Jan 1975. Translated from German report.

In Reports of the Nuclear Research Center, Karlsruhe. 7th annual publication.

Results of studies on the cryogenic resistance behavior of high-grade Al are presented. Discussions and data are included on production of high-purity Al, determination of electric conductivity, and magnetoresistance. (JRD)

8982 **Prediction of dielectric breakdown in shock-loaded ferroelectric ceramics.** Lysne, P.C. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.;* **46**: No. 1, 230-232(Jan 1975).

Recent investigations of dielectric breakdown of a poled ferroelectric ceramic suggest that the same mechanisms are active in shock-loading and ambient-condition experiments. Further work described here supported this view for PZT 65/35. Breakdown in shock-loaded specimens can be predicted from ambient and quasi-static-loading data using the concept of a critical particle energy. The effects of the ferroelectric-to-paraelectric transformation and other factors are discussed for shock-loaded PZT materials. (auth)

8983 **Properties of amorphous and microcrystalline superconductors.** Johnson, W.L.; Poon, S.J. (California Inst. of Tech., Pasadena). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 189-191(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Results of x-ray diffraction, electrical resistivity, critical field(H/sub c2/) and transport measurements are presented and discussed for bulk amorphous and microcrystalline transition metal alloys (Au—La, Nb—Rh, Nb—Ni—Rh, and Pd—Zr) obtained by liquid quenching. The transition temperature of the alloys is in the range 1.5 to 4.7°K. The J/sub c/—H/sub c2/—T/sub c/ relations are rather simple for this class of material and are compared with the theories of type II superconductors. The high resistance of bulk metallic glass to radiation damage might render them suitable for magnetic field applications in high radiation environments. (auth)

8984 Bulk superconductivity above 20 K in Nb_3Ge. Newkirk, L.R.; Valencia, F.A.; Giorgi, A.L.; Szklarz, E.G.; Wallace, T.C. (Los Alamos Scientific Lab., NM). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 221-224(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The superconducting properties of bulk films (0.02 to 0.06 mm thick) of Nb_3Ge deposited on Cu substrates by chemical vapor deposition were studied along with physical parameters characterizing these deposits. Results of susceptibility measurements showing superconducting onsets greater than 21°K and resistivity measurements showing onset greater than 22°K are presented along with heat capacity measurements. Data are also presented defining a relationship between superconducting transition temperature and lattice spacing throughout the range of 4 to 21°K. In addition, the effects of substrate temperature and substrate material, as well as mechanical properties such as substrate adherence, are described. (auth)

8985 Effect of metallurgical history on "J/sub c/(5T)" in surface diffuse multifilamentary Nb_3Sn. McInturff, A.D. (Brookhaven National Lab., Upton, NY); Larbalestier, D.C. *IEEE Trans. Magn.*; **MAG-11**: No. 2, 259-262(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Data are presented of critical current density "J/sub c/(5T)" in a 5 T perpendicular magnetic field (and 10 T as well for selected samples) for multifilamentary Nb_3Sn formed by Sn diffusion from a Cu—Nb composite's outer surface. The parameters varied are: composite diameter and Cu/Nb ratio, Sn percentage, filament diameter, reaction temperature, and time. The composite diameter varied from 0.254 to 0.08 mm; Cu/Nb volume ratio from 1.7 to 3; volume percentage of Sn from 2 to 13.8 percent; average filament diameter from 2 microns to 7 microns. The reaction temperature was varied between 550 to 795°C for different lengths of time, one to several thousand hours. A three-stage heat treatment was selected to formulate the basis for the reaction heat treatment map. The J/sub c/(5T) varied from 10^2 to greater than 3×10^5 A/cm² over the entire composite cross section (Cu—Sn, Nb_3Sn, Nb). The optimum performances were 38.8 A in 0.127 mm diam 1.9/1 Cu/ (Nb + Nb_3Sn) composite at 5 T and 78 A in a 0.18 mm diam 3/1 Cu/ (Nb + Nb_3Sn) at 5 T. 12 figures. (auth)

8986 Fabrication and properties of multifilament Nb_3Sn conductors. Randall, R. (Supercon Inc., Natick, MA); Wong, J.; Deis, D.W.; Shaw, B.J.; Daniel, M.R. *IEEE Trans. Magn.*; **MAG-11**: No. 2, 291-294(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Multifilament conductors have been fabricated in several configurations employing various combinations of Cu, Sn, Cu—Sn bronze, and Nb. These conductors are in the 8 to 100 mil size range and contain 400 to 13,000 filaments. Filament sizes range from 8 to 100 microns in diameter. Heat treatment studies and their effect upon superconducting properties have been performed for temperatures in the range 600 to 800°C. Sample evaluation has included measurements of T/sub c/, resistivity, and J/sub c/ up to 150 kG. Mechanical tests to assess allowable bending diameters and metallurgical studies to determine the distribution of constituent elements subsequent to heat treatment were made. Results are discussed and compared in the context of optimizing the properties of these conductors for high-field magnet applications. (auth)

8987 Ac losses of Nb_3Sn. Bussiere, J.F.; Garber, M.; Suenaga, M. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 324-327(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

60-Hz losses were measured at 4.2°K in a number of Nb_3Sn rods and tapes produced by the bronze-diffusion process and in commercial Nb_3Sn tapes. At low fields (less than or equal to 900 Oe), losses vary by more than two orders of magnitude among the different samples and are related to surface topography. At high fields (greater than or equal to 2 kOe) the variation among samples is much less, and depends mainly on the bulk critical current density J/sub c/. The losses are analyzed quantitatively in terms of the critical state model, including a surface current. (auth)

8988 Critical current density in superconducting niobium films. Huebner, R.P. (Argonne National Lab., IL); Kampwirth, R.T.; Martin, R.L.; Barbee, T.W.; Zuebeck, R.B. *IEEE Trans. Magn.*; **MAG-11**: No. 2, 344-346(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The critical current was measured at 4.2°K in Nb-strips of 1 μm thickness and different width, w, prepared by electron-beam vacuum-deposition. The substrate temperature during the deposition was varied between room temperature and 800°C. The width of the Np strips ranged between 20 and 300 μm. Whereas up to 600°C the different substrate temperatures yielded about the same average critical current density, J/sub c/, (critical current divided by sample cross section) the specimens prepared with 800°C substrate temperature showed a reduction of J/sub c/ by a factor of 4-6. In zero applied magnetic field, the samples prepared with 400°C substrate temperature or lower showed a decrease of J/sub c/ roughly proportional to w/sup $^1/_2$/. The critical current data obtained in an applied perpendicular field, for the high-field regime, were compared with Kramer's theory of flux pinning which assumes plastic shearing of the flux-line lattice around individual pinning sites during flux flow. (auth)

8989 Ac critical currents of commercial Nb_3Sn tapes. Garber, M.; Shen, S.; Bussiere, J.; Morgan, G. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 373-376(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Quench currents and critical currents have been measured for a number of commercial Nb_3Sn tapes at 4.2°K. The measurements were made at 60 Hz. The observed quench currents in the as-received tapes are considerably lower than the critical currents, which can be determined by a new technique after stabilizing material is added. The temperature dependence over the entire range above 4.2°K was measured for two of the samples. The critical current falls off approximately as $1-(T/T/\text{sub } c/)^2$. (auth)

8990 Analytical study of current-sharing at power frequency between a type II superconducting composite with a normal metal backing. Morgan, G. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 401-404(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Current sharing in a two-layer composite is studied analytically by numerically solving the 1-dimensional diffusion equation in the normal metal and the phenomenological critical state model with field independent critical current density J/sub c/ (T) in the superconductor, with boundary conditions appropriate to a transmission line at each surface and the interface. It is found that with a sufficiently low resistivity (rho) backing, and reasonable assumptions as to heat transfer, an appreciable fraction of a current density of several thousand amps per cm can be carried in the backing with the balance in a superconductor with high T/sub c/ such as NB_3Sn. The dependence of the dissipation on such parameters as thickness, J/sub c/, rho and frequency at constant temperature is given, and typical loss voltage waveforms presented. (auth)

8991 Critical current densities in Nb_3Ge between 14 and 21 K. Bartlett, R.J.; Laquer, H.L.; Taylor, R.D. (Los Alamos Scientific Lab., NM). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 405-407(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Self field critical current densities of thick Nb_3Ge films were measured in the liquid hydrogen temperature range 13.8 to 21°K. Bulk critical current densities J/sub c/ above 1.6×10^6 A/cm² were observed at 14°K, falling linearly at higher temperatures. The behavior extrapolated to zero critical current gave a critical temperature T/sub c/ approximately 19.2°K which is approximately 1.5°K lower than the onset T/sub c/ determined from the ac magnetic susceptibility. The samples were long sections of copper tubes, which had been coated on the inside with Nb_3Ge by a chemical vapor deposition process. J/sub c/ for various high T/sub c/ materials are compared including calculations of adiabatic stability. Nb_3Ge holds promise for a dc superconducting power transmission line operating near 14°K. (auth)

8992 Multipole magnetic field trapping by superconductors. Rabinowitz, M. (Electric Power Research Inst., Palo Alto, CA). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 548-550(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Multipole magnetic fields up to 17,600 Oe were trapped transversely to the axes of solid, hollow, and split hollow superconducting cylinders. Dipole, quadrupole, and sextupole magnetic fields were permanently stored with high fidelity to the original fields using Pb, Nb, and Nb_3Sn. The advantages of this technique are manifold: 1. Only one pattern magnet has to be made, whose field, regardless of configuration, may then be inexpensively replicated ad infinitum. 2. There is a saving of space, weight, and material. 3. There is a saving of electrical power, as the only power loss is due to heat conduction. 4. The stored magnetic field can remain extremely stable over long periods of time. 5. The magnetic field can persist for long durations even during power curtailments or shutdowns. This paper will explore the advantages and limitations of this technique, experimental results, geometry effects, and possible applications. (auth)

8993 Superconductivity in amorphous and microcrystalline transition-metal alloys. Johnson, W.L.; Poon, S.J. (California Inst. of Tech., Pasadena). *J. Appl. Phys.*; **46**: No. 4, 1787-1792(Apr 1975).

Results of x-ray diffraction, electrical resistivity, critical magnetic field, and transport measurements for several bulk amorphous and microcrystalline transition-metal superconductors obtained by liquid quenching are presented and discussed. Simple J/sub c/-H/sub c2/-T/sub c/ relations are observed for this class of materials. A linear relation between electronic diffusivity and nearest-neighbors distance is derived from critical field measurements. The relationship between the formation of an amorphous phase by rapid cooling from the liquid state, lattice stability, and the characteristics of phase diagrams are discussed. (auth)

8994 Study of tunneling in superconducting indium: tin alloys. Galkin, A.A.; Svistunov, V.M.; Revenko, Y.F.; Mostovoi, V.M. (Donets Institute of Physics and Engineering, Academy of Sciences of the Ukrainian SSR). *Sov. Phys. - Solid State (Engl. Transl.)*; **17**: No. 5, 968-969(May 1975).

The tunnel effect in the α phase of In-Sn alloys was studied. The dependence of the critical temperature and the energy gap on the impurity concentration was investigated. The phonon spectrum is reported. (AIP)

8995 Investigation of dilute magnetic impurities via the Moessbauer effect: Ag ^{57}Fe and Ag ^{57}Co. Thompson, J.R.; Thomson, J.O. (Oak Ridge National Lab., TN). *Phys. Rev., B;* **12**: No. 7, 2572-2578(1 Oct 1975).

The dilute Kondo alloys Ag^{57}Fe and AG^{57}Co were studied via the Mossbauer effect at temperatures between 0.022 and 4.2°K and in applied magnetic fields from 0 to 60 kG. For Fe in Ag, this allows study of both the thermal and magnetic breakup of the nonmagnetic ground state. Where they overlap the results agree with those of Kitchens, Steyert, and Taylor. As the temperature is lowered, a strong reduction from free spin behavior of the local moment is observed. At the lowest temperatures the dependence of the Fe-hyperfine field on applied field is compared with several theoretical and semiempirical expressions, where each describes the data moderately well, none with marked superiority. The first measurements of the hyperfine field of ^{57}Co in Ag, obtained via the intensity asymmetry of the spectra is reported. The field can be described in terms of a large positive Knight shift K = (28 +- 8) percent. (auth)

8996 Electrical characteristics of metal/Si—Ge contacts. Pike, G.E.; Sweet, J.N. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; **46**: No. 11, 4904-4920(Nov 1975).

Measurements and theoretical calculations were made of the electrical properties of metal contacts to a polycrystalline Si--Ge alloy (80 at. percent Si) for a wide variety of conditions. Thin-film contacts of W, Pb, and In were formed on Si--Ge phosphorus doped in the range 2 x 10^{18} - 1 X 10^{20} cm^{-3}. For P concentrations near 2 x 10^{19} cm^{-3}, samples having several interfacial oxide thicknesses were produced. W contacts to this material were heat treated to simulate elevated-temperature aging effects of W thin-film contacts on thermopiles. The differential conductance for all these various contacts was measured as a function of bias voltage for temperatures from 1.1 to 300 K. Comparison of theory with experiment leads to the conclusion that the general features of the conductance characteristics can be predicted from the theory for certain ranges of oxide thickness and dopant concentration. Agreement appears to be best for thin oxides and P concentrations near 2 x 10^{19} cm^{-3}, with both higher- and lower-doped contacts behaving qualitatively as if their effective doping levels were nearer this value. This effect was interpreted in terms of phosphorus depletion or enhancement mechanisms occurring in the Si--Ge depletion region during junction fabrication. When W contacts are heat treated after fabrication, agreement with theory improves. This is believed to occur as a result of dopant redistribution effects in the depletion region. Junctions with In or Pb electrodes exhibit typical superconducting conductances at 1.1°K, thus showing that tunneling is, in fact, a major transport mechanism in Si--Ge/metal junctions. (auth)

8997 Thermoelectric size effect in noble metals. Moreland, R.F.; Bourassa, R.R. (Univ. of Oklahoma, Norman). *Phys. Rev., B;* **12**: No. 10, 3991-3998(15 Nov 1975).

The difference between the thermoelectric power of thin foils ranging in size from 2.54 X 10^{-2} to 1.52 X 10^{-3}mm and a 0.254-mm wire of gold, copper, and silver was measured as a function of temperature from 4.2 to 333°K. The electrical resistance of the wire and the foils was measured at 4.2, 77.3, and 296°K. From the high-temperature results values were obtained for [delta ln(ϵ)/delta ln ϵ]/sub ϵ F/ and [delta lnA(ϵ)/ln ϵ]/sub ϵ F/ of -0.58 +- 0.08 and -1.00 +- 0.08 for gold, -0.34 +- 0.11 and -1.20 +- 0.11 for copper, and +0.86 +- 0.09 and -1.91 +- 0.09 for silver, respectively. Analysis of the low-temperature results suggests that the thermoeletric size effect can be used to determine subparts per million concentrations of magnetic impurities in the noble metals. (auth)

8998 Diffusion model and the anisotropic relaxation time in metals: application to potassium. Lawrence, W.E. (Dartmouth Coll., Hanover, NH). *Phys. Rev., B;* **12**: No. 10, 4161-4183(15 Nov 1975).

The Boltzmann equation for the anisotropic relaxation time leads to a generalization of the diffusion model in which umklapp electron-phonon scattering is treated explicitly, and does not require Fermi-surface distortion or intersection with zone boundaries. The diffusion equation contains an anisotropic function which may be interpreted as the zeroth-order relaxation time in the iteration sequence of the Boltzmann equation, and which has been used commonly as an approximation to the true relaxation time. The solution of the diffusion equation tends toward this zeroth-order relaxation time at higher temperatures, where the latter is known to become a good approximation. The importance of treating umklapp explicitly is illustrated by calculating deviations from Matthiessen's rule in the electrical resistivity of potassium, for which previous diffusion models were of course not intended. Comparison with data and with previous numerical calculations by others lends credence to the model. (auth)

8999 Dislocation motion in superconductors. Galligan, J.M.; Tregilgas, J.H. (Univ. of Connecticut, Storrs). *Scr. Metall.*; **9**: No. 12, 1321-1323(Dec 1975).

The strain rate sensitivity of the flow stress of pure Pb crystals was measured at 4.2°K. It was found that the effects of changing the strain rate on the flow stress is much more pronounced when the crystal is deformed in the normal state than when the crystal is deformed in the superconducting state. (JRD)

9000 Surface reaction controlled oxygen absorption in a Ta-8 W-2 Hf alloy: kinetics and concentration gradients. Carpenter, R.W.; Liu, C.T. (Oak Ridge National Lab., TN). *Metall. Trans., A;* **6A**: No. 12, 2235-2241(Dec 1975).

It is known that the rate of oxygen absorption in several bcc metals and alloys under conditions of low oxygen pressure and high temperature is controlled by the absorption rate of oxygen at the gas-metal interface, but the relationships between absorption rate, oxygen concentration gradient, and average oxygen concentration were not previously studied in detail. These relationships are examined using several different solutions of the diffusion equation to represent the absorption process, and the relations derived are compared with oxygen absorption measurements for a Ta—8 W—2 Hf alloy under the appropriate experimental conditions. It was found that the absorption rate and oxygen gradient were accurately described by a solution of the diffusion equation using a constant oxygen flux into the specimen as the external boundary condition. The rate limiting step in the process is the oxygen absorption rate at the gas-metal interface. This phenomenological model should also properly describe the oxygen absorption behavior of pure metals under the same conditions when the process is controlled by the absorption rate at the gas-metal interface, provided the sticking coefficient does not change during absorption. (auth)

9001 Heat capacity of technetium. Trainor, R.J.; Brodsky, M.B. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B;* **12**: No. 11, 4867-4869(1 Dec 1975).

The heat capacity of technetium has been measured in zero field between 3 and 15 K. A superconducting transition tempera-

ture T/subc/ = 7.86 K is found. The electronic heat-capacity coefficient and zero-degree Debye temperature are 4.30 mJ/mole K^2 and 454 K, respectively. An electron-phonon enhancement factor of 0.65 is found from the McMillan equation. The thermodynamic properties of the superconducting state also indicate that technetium is an intermediate-coupling superconductor. (AIP)

9002 Field dependence of the superconductive penetration depth in tin up to the superheating limit. Parr, H. (Institute of Physics, University of Oslo, Oslo 3, Norway). *Phys. Rev., B;* **12**: No. 11, 4886-4898(1 Dec 1975).

The superconductive penetration depth δ (T, H) has been studied as a function of temperature and field in single tin spheres, 15—30 μm in diameter. A mutual-inductance method was used with the 75-kHz measuring field parallel to the static field. When properly normalized, the variation of the transition signal with T and H is then proportional to ddelta-bar (T, H) times H/dH, where delta-bar is the penetration depth averaged over the sphere surface. The results are independent of sphere diameter, and thus characteristic of bulk tin. In zero field $\delta(T) = \delta_0/1 - (T/T/subc/)^{4}/^{3}$, with δ_0 = 520 plus-or-minus 30 A. The field dependence was studied for temperatures close to T/subc/ and fields up to the ideal bulk superheating field H/sub sh/ ≅ 2.76H/subc/, corresponding to a Ginzburg-Landau parameter κ = 0.093 plus-or-minus 0.001. The penetration depth increases sharply as the field approaches H/sub sh/, but stays finite, while its derivative diverges. We find δ (H/sub sh/)/δ (H = 0) = 1.51 plus-or-minus 0.04. Averaged over the sphere, we have delta-bar (H/sub sh/)/delta-bar (H = 0) = 1.19 plus-or-minus 0.01. The field dependence is rather well described by one-dimensional Ginzburg-Landau theory in the low-κ limit. The results indicate that the surface order parameter psi/subs/ is depressed by 30 to 50 % at H/sub sh/ . In "weak" fields, H less than or equal to 1.5H/subc/, the data are consistent with the customary quadratic field dependence. (AIP)

9003 Measurements of the electron-phonon interaction in Nb by inelastic neutron scattering. Shapiro, S.M.; Shirane, G.; Axe, J.D. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B;* **12**: No. 11, 4899-4908(1 Dec 1975).

Precise linewidth and frequency measurements of transverse acoustic modes propagating along the 001 and 110 directions were performed on single crystals of niobium in the normal and superconducting phases (T/subc/ = 9.2 degree K). For transverse phonons propagating along the 110 direction changes in linewidth are observed when the superconducting gap 2Δ (T) equals the phonon frequency. This behavior agrees with Bobetic's calculation for the attenuation of high-frequency sound waves in superconductors and the magnitude of the change makes it possble to calculate the electron-phonon interactions. In addition to linewidth changes, anomalous temperature dependence of the peak position of some acoustic modes is also observed. The 001 transverse phonons exhibit a decrease of ~ 15% when T is decreased from 300 degree K to T/subc/. Below T/subc/ there is an additional softening of 3%. This softening extends along the zeta00 direction to zeta = 0.5, the limit of the measurements. (AIP)

9004 Nonequilibrium quasiparticle current at superconducting boundaries. Yu, M.L.; Mercereau, J.E. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B;* **12**: No. 11, 4909-4916(1 Dec 1975).

Potential measurements have been made in the nonequilibrium depairing regions of current-carrying superconducting boundaries. Experiments performed on two different systems are reviewed. The first is the boundary between a superconductor and a normal metal. The second is the boundary between two superconductors with one of them driven normal by a current. In both cases, the quasiparticle chemical potential was found to be different from the potential of the pairs with current dependence depending on individual boundary conditions. The spatial extent of the nonequilibrium region was also found to be longer than the coherence length of the superconductor. A new interpretation for the experimental results is proposed. The theory is based on a nonequilibrium population of quasiparticles created during branch crossing in the depairing region. The branch-crossing relaxation time tau/subQ/ (0) for our tantalum films was estimated to be ~ 0.65 times 10^{-10} sec. (AIP)

9005 Low-temperature heat capacity of α-uranium and its relation to the pressure dependence of T/subc/ . Bader, S.D.; Phillips, N.E.; Fisher, E.S. (Inorganic Materials Research Division of the Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Phys. Rev., B;* **12**: No. 11, 4929-4940(1 Dec 1975).

The heat capacities of five samples of α-uranium, including one single crystal, have been measured between approximately 0.1 and 2 K, at zero pressure. The four polycrystalline samples showed broad bulk superconducting transitions. The single crystal, for which susceptibility measurements showed a transition near 0.3 K, was not completely superconducting at the lowest temperature, and an estimate T/subc/ less than or equal to 0.1 K was made. The shapes of the heat-capacity anomalies associated with the transitions to the superconducting state were those of broadened BCS transitions, thus showing that local moments and pair-breaking mechanisms are not involved in limiting the values of T/subc/. The value of γ, the coefficient of the electronic heat capacity, were significantly higher for the polycrystalline samples than for the single crystal, and there is evidence from other work of a similar trend in the lattice heat capacity. It is suggested that these trends are related to the pressure dependence of the same parameters, and that these pressure dependences and that of T/subc/ are all produced by an unusual and strong pressure dependence of the phonon spectrum. (AIP)

9006 Superconducting transition temperature in ϵ-phase Ag-Zn alloys. Matsuo, S.; Mizutani, U.; Massalski, T.B.; Noguchi, S. (Department of Applied Physics, Nagoya University, Nagoya, 464, Japan). *Phys. Rev., B;* **12**: No. 11, 4941-4944(1 Dec 1975).

Superconducting transition temperatures were measured in four ϵ-phase alloys in the Ag-Zn system, in order to obtain a relation between the electron-phonon interaction and the electron concentration (electrons per atom, z). The results show that the strength of the interaction increases with z throughout the ϵ-phase range but the increase becomes negligible for values of z exceeding about 1.85. This change of behavior appears to coincide with the onset of electron overlaps across the {00.2} faces of the Brillouin zone, as indicated by other properties. (AIP)

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 8165, 8187, 8965

9007 (WARD-NA—3045-26) **Sodium technology program: component materials compatibility. Quarterly progress report for period ending April 30, 1975.** Ray, W.E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nov 1975. Contract E(11-1)-3045. 74p. AT.

1. Interstitial Transfer: A series of short-term exposures were performed in CEL-2 in an effort to determine the reason for the carburization of ITF-5 specimens. It appears that incomplete alcohol cleaning after sodium exposure can cause carburization of stainless steel. Run ITF-6 continued with specimens in the IHX, secondary heater, and by-pass sections accumulating approximately 2250 hours of exposure. The primary heater samples have been exposed for about 1560 hours. CEL-1 and CEL-2 experiments revealed two important facts related to the use of 2¼ Cr—1 Mo alloy in the LMFBR: Annealed material has a stable structure and will not lose carbon in sodium at 950°F to levels which would require modification of allowable stresses. Secondly, normalized or normalized and tempered structures, especially those experiencing an initial rapid cooling, are unstable at steam generator temperatures and are prone to serious decarburization and mechanical property degradation. X-ray microprobe analysis of ITF-4 and -5 indicate considerable departure from corrosion trends established earlier. 2. Sodium Effects on Mechanical Properties: Four tests of Inconel 718 in the MTS fatigue machine at 1000°F yielded typical hysteresis loops for load-strain plots. The strain range vs fatigue life curve showed that the elastic and plastic strain ranges obey a linear relationship when plotted on logarithmic coordinates. Low cycle-fatigue tests on Type 316 stainless steel at 1100°F in flowing sodium show that samples pre-treated at 1200°F have a greater creep/fatigue life than those pre-treated at 1325°F. Since the samples pre-treated at 1325°F are weaker and more ductile than those pre-treated at 1200°F, the trend is consistent in that increased ductility increases the fatigue life, whereas decreased strength decreases the creep life. 29 fig, 6 tables (DLC)

9008 (AEC-tr—7295, pp 109-115) **Corrosion kinetics of stainless steels and aluminum in N_2O_4.** Sukhotin, A.M.; Lantratova, N.Ya.; Antropov, N.P.; Samoilyuk, P.P. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

A resistance-measurement method was developed for determining low corrosion rates of thin wires in N_2O_4 atmospheres. Tests were performed on 0.1-0.2 mm dia wires; data are presented for Al, Kh18N10T, and 2Kh13N1MV1 in liquid and gaseous N_2O_4. Effects of passivation were studied. (DLC)

9009 (AEC-tr—7295, pp 116-123) **Stability of construction materials in N_2O_4 at high pressures and temperatures.** Sukhotin, A.M.; Lantratova, N.Ya.; Matushkin, V.A.; Polyakova, R.E.; Laterner, S.A. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Corrosion stability of Cr—Ni steels, Cr steels, Ni alloys, Al alloys, and Ti alloys in gaseous equilibrium nitrogen oxides was studied up to 700°C and 150 atm. (DLC)

9010 **Analysis of the decarburization and aging processes in 2 1/4 Cr—1 Mo steel.** Klueh, R.L.; Leitnaker, J.M. (Oak Ridge National Lab., TN). *Metall. Trans., A;* **6A**: No. 11, 2089-2093(Nov 1975).

Specimens of $2^1/_4$ Cr—1 Mo steel that had been decarburized in sodium or aged in an inert atmosphere for 26,500 h at 839°K were metallurgically examined with optical and transmission electron microscopy. The carbide particle density of the decarburized and aged specimens was considerably less after 26,500 h than after 10,000 h, with the density in the aged specimen being considerably greater than that in the decarburized specimen. For the aged specimen, the density decrease was a result of Ostwald ripening, and the total amount of carbide was not noticeably affected. Decarburization, however, resulted in a gradient in carbide density, with the smallest density near the surface. Carbides were electrolytically extracted and identified by x-ray diffraction. From the before-test material, which was in the annealed condition and had a ferrite-pearlite microstructure, 1.4 wt percent carbide was obtained. This sample contained M_3C, $M_{23}C_6$, and M_6C, with $M_{23}C_6$ constituting the major portion. In the aged specimen, 2.3 wt percent of precipitate was extracted and contained 60 percent M_6C, the balance $M_{23}C_6$. The decarburized specimen contained two regions with different carbide contents. The first 20 percent of the 1.6 mm thick specimen yielded 1.3 wt percent precipitate, which contained 94 percent M_6C, the balance $M_{23}C_6$. The interior of the specimen contained 1.6 wt percent precipitate, 86 percent M_6C. (auth)

9011 **Photoemission for Xe physisorbed on W(100): Evidence for surface crystal-field effects.** Waclawski, B.J.; Herbst, J.F. (National Bureau of Standards, Washington, D.C. 20234). *Phys. Rev. Lett.;* **35**: No. 23, 1594-1596(8 Dec 1975).

Photomeission spectra at $h\nu$=21.2 eV reveal two 5p levels for xenon physisorbed on a tungsten (100) surface. The spin-orbit splitting of the two levels and their intensity ratio correspond closely to gas-phase measurements, while the $5p_{3/2}$ peak is significantly broadened with respect to the $5p_{1/2}$. The broadened structure is interpreted as an unresolved doublet resulting from splitting the Xe $5p_{3/2}$ states in the tungsten surface crystal field. (AIP)

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 8553, 8936, 8970, 9081, 9979

9012 (AI-ERDA—13164) **Swelling and mechanical property changes in neutron-irradiated cold-rolled type 316 stainless steel.** Garr, K.R.; Pard, A.G. (Rockwell International Corp., Canoga Park, Calif. (USA). Space Div.). 1975. Contract AT(04-3)-824. 22p. Dep. NTIS $4.00.

Samples of cold-rolled Type 316 stainless steel were irradiated in EBR-II to a fluence of about 8 x 10^{26} n/m² (E greater than 0.1 MeV) at 500 and 600°C. Three sample configurations were used—small sheet tensile samples, small right-circular cylinders for immersion density, and thin foils for transmission-electron microscopy (TEM). TEM revealed voids in the foils irradiated at both temperatures. Immersion density results, however, indicated swelling only in the sample irradiated at 600°C. Considerable recovery and precipitation were observed in foils irradiated at both temperatures. Results of tensile tests on irradiated samples showed a decrease in yield strength and an increase in ductility compared to unirradiated controls. (auth)

9013 (CONF-740651—7) **Evaluation of commercial production A533-B plates and weld deposits tailored for improved radiation embrittlement resistance.** Hawthorne, J.R.; Koziol, J.J.; Byrne, S.T. (Naval Research Lab., Washington, D.C. (USA); Combustion Engineering, Inc., Windsor, Conn. (USA)). 1974. 14p.

From Symposium on the effects of radiation on structural materials; Gatlinburg, Tennessee, USA (11 Jun 1974).

A cooperative AEC/C-E/NRL research program is exploring trends in radiation effects for commercially produced ASTM A533-B steel plates, weld deposits, and weld heat affected zones with three controlled levels of impurity copper content. The primary objective is to establish the trend of improved 550°F (288°C) radiation performance with progressive reductions in allowable copper content. Objectives are to develop information assisting the formulation of special specifications for steels for nuclear service and the delineation of associated embrittlement trends for vessel design and operation. This report summarizes findings on the radiation resistance of two of three series of A533-B plates and weldments. Series 1 materials contained greater than or equal to 0.15 percent Cu, typical of nonimproved steel production (pre-1971). Series 2 materials contained 0.10 percent Cu max, representative of improved steel production (current practice). Radiation resistance was assessed from Charpy-V (Cv) notch ductility changes with irradiation to two fluence levels: 2-3 x 10^{19} and 4.5 x 10^{19} n/cm² greater than 1 MeV. Data trends indicate a marked improvement in radiation resistance with the specification of 0.10 percent max Cu. The improvement is evident both in a smaller increase in Cv 30 ft-lb transition temperature and in a smaller decrease in Cv upper shelf energy with irradiation. New ASTM and AWS specifications proposing to restrict the copper, phosphorous and sulfur contents of A533-B plates and weld deposits for nuclear service are reviewed and appear well formulated from the experimental findings presented here. The effectiveness of postirradiation 650 F (343 C)-168 hour heat treatment for notch toughness recovery was also explored. 12 fig, 6 tables. (auth)

9014 (CONF-750989—3) **HVEM quantitative stereoscopy through the full damage range of an ion-bombarded Fe—Ni—Cr alloy.** Diamond, S.; Baron, I.M.; Bleiberg, M.L.; Bajaj, R.; Chickering, R.W. (Westinghouse Electric Corp., Madison, Pa. (USA)). 1975. 24p. Dep. NTIS $3.50.

From International conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (30 Sep 1975).

The swelling of a Ni-ion irradiated Fe—25 percent Ni—15 percent Cr alloy has been investigated employing high voltage (1 MeV) electron microscopy. Helium pre-injected samples were irradiated to a maximum dose of 92 dpa with 3.5 MeV $^{58}Ni^+$ ions at 600, 650, 700 and 750°C. By means of quantitative stereoscopy throughout the full range of ion damage, the void morphology, swelling, and dislocation morphology as functions of the distance from the ion-entry surface of the foil were obtained. The dose also varied as a function of depth and, with this technique, swelling as a function of dose was determined from a single sample at each temperature. Swelling, void concentration, and void size varied with irradiation temperature with the maximum swelling of 7.4 percent occurring at 700°C. Several distinct dislocation configurations could be distinguished progressing inward from the ion-entry surface. The observations suggest that nucleation and growth of voids are related to dislocation densities and possibly to dislocation structure. The swelling-dose relationships were analyzed using a linear expression for each apparent swelling regime and the results interpreted in terms of the Brailsford and Bullough statistical rate theory. Two distinct steady-state swelling regimes exist at each irradiation temperature and the difference in the rates is attributed to the different kinetic development of the dislocation structure and densities in the two stages. (auth)

9015 (HEDL-SA—765) **Relationship between equivalent chromium content and irradiation-induced swelling in 316 stainless steel.** Bates, J.F.; Guthrie, G.L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-2170. 16p. (CONF-750607—39). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A correlation is noted between equivalent chromium content and resistance to irradiation induced swelling in various 316 stainless steel specimens which have slightly different chemical compositions. Several examples are cited where an increased concentration of an α-stabilizing minor constituent results in decreased swelling. It is shown that the relative swelling resistance of alloys having the same carbon and equivalent nickel contents is higher for those alloys with the higher equivalent chromium content. (auth)

9016 (ERDA-tr—86, pp 74-80) **European conference on the radiation behavior of materials for fuel rod jackets and nuclear components.** Closs, K.D. Jan 1975. Translated from German report.

In Reports of the Nuclear Research Center, Karlsruhe. 7th annual publication.

Experimental results and theoretical concepts given at the conference are presented concerning pore formation under irradiation, effects of irradiation on structural stability, and radiation effects on mechanical properties of materials. (JRD)

9017 Many-body effects in x-ray photoemission from magnesium. Ley, L.; McFeely, F.R.; Kowalczyk, S.P.; Jenkin, J.G.; Shirley, D.A. (Univ. of California, Berkeley). *Phys. Rev., B;* **11**: No. 2, 600-612(15 Jan 1975).

X-ray photoemission experiments were performed on samples of magnesium and aluminum prepared with clear surfaces in ultrahigh vacuum. Core-level binding energies were in excellent agreement with x-ray emission data. Asymmetries in core-level peaks were observed and are compared with theory. The Mg KLL Auger spectrum showed kinetic energies higher than the literature values. Many-body effects, in the form of extra-atomic relaxation, were present in core levels and Auger lines. Both KL/sub i/V and $KL_{2,3}V$ Auger peaks of Mg were observed. Many-body effects were also manifest as rich plasmon satellite structure accompanying every primary peak. The valence-band spectrum was compared with x-ray emission data and with the $KL_{2,3}V$ peak. The spectra were interpreted in terms of energy-level diagrams rather than one-electron levels. It is argued that valence-band spectra obtained by different methods can be compared most directly among states with the same number of core holes. A hierarchical classification of hole states is suggested. The effect of the degree of localization of the hole state on the relaxation energies in metals is discussed and shown to be small. It was observed that in several light metals the energies required to remove a valence-bond electron or a unipositive ion core are about equal. (auth)

9018 Neutron induced disorder in superconducting A-15 compounds. Sweedler, A.R. (Brookhaven National Lab., Upton, NY); Cox, D.; Schweitzer, D.G.; Webb, G.W. *IEEE Trans. Magn.;* **MAG-11**: No. 2, 163-165(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The effect of high energy neutron (E greater than 1 MeV) irradiation at 60°C on the superconducting critical temperature, T/sub c/, the upper critical field, H/sub c2/, the lattice parameter, a_0, and the degree of Long Range Order has been measured for Nb and V based A-15 superconducting compounds. Large reductions in T/sub c/° and H/sub c2/ are observed for fluences up to 5.0 x 10^{19} n/cm². For Nb_3Al, a_0 increases and the degree of Long Range Order is significantly reduced as T/sub c/ is depressed. Results are discussed in terms of atomic ordering in the A-15 structure. (auth)

9019 Neutron irradiation of Nb_3Sn and NbTi multifilamentary composites. Parkin, D.M.; Sweedler, A.R. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 166-169(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

NbTi and Nb_3Sn multifilamentary composites were irradiated with fast neutrons at 60 +- 5°C to fluences of 1.2 x 10^{20} n/cm² (E greater than 1 MeV). The NbTi samples show only a moderate reduction of I/sub c/ as a function of neutron fluence in an applied field of 40 kG. Reductions in I/sub c/ were observed for fluences greater than 3 x 10^{17} n/cm² and saturate at 18 percent for fluences greater than 3-4 x 10^{19} n/cm². The Nb_3Sn composites showed large neutron radiation-induced changes in T/sub c/, I/sub c/, and H/sub c2/. Reductions in T/sub c/ were observed for fluences greater than 7 x 10^{17} n/cm². No measurable changes in I/sub c/(40 kG) were observed below 10^{18} n/cm². Between 2 and 3 x 10^{18} n/cm², however, there is an apparent threshold where a very rapid reduction in I/sub c/(40 kG) is initiated. At the threshold the decrease in T/sub c/ is 13 percent. Between the threshold and 1.1 x 10^{19} n/cm², I/sub c/(40 kG) was reduced to 4 percent of the unirradiated value. These changes in superconducting properties in NbTi and Nb_3Sn are analyzed in terms of the radiation-induced defects. The impact of the response to irradiation of both materials on their applications in fusion reactor magnets is discussed. (auth)

9020 Yield strength of fine-grained vanadium produced by high-rate physical vapor deposition. Sherman, M.A. (Los Alamos Scientific Lab., N.Mex. (USA)); Bunshah, R.F. (California Univ., Los Angeles (USA). Dept. of Materials). *J. Nucl. Mater.;* **57**: No. 2, 151-154(Aug 1975).

High-rate physical vapor-deposition (HRPVD) techniques were used to produce vanadium bulk deposits with a 0.7 μm grain size and average yield strength of 36.1 kg/mm². The strength is well above previous values. Vanadium of this grain size is expected to resist void formation and growth under fast-neutron irradiation compared to the recrystallized material. (NL)

9021 Relationship between equivalent chromium content and irradiation-induced swelling in type 316 stainless steel. Bates, J.F.; Guthrie, G.L. (Westinghouse Hanford Co., Richland, WA). *Nucl. Technol.;* **27**: No. 2, 286-291(Oct 1975).

The equivalent chromium content of Type 316 stainless steel is shown to be directly related to irradiation-induced swelling in specimens that have slightly different chemical compositions. In some cases, increased concentrations of an α-stabilizing minor constituent—silicon, phosphorus, and molybdenum—resulted in decreased swelling. The relative swelling resistance of alloys having the same carbon and equivalent nickel contents will be higher for those alloys with the higher equivalent chromium content. (auth)

9022 Neutron-inelastic-scattering measurements of phonon perturbations by defects in irradiated copper. Nicklow, R.M.; Coltman, R.R.; Young, F.W. Jr.; Wood, R.F. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **35**: No. 21, 1444-1447(24 Nov 1975).

Neutron-scattering measurements have been made at 10°K of phonons in a copper crystal neutron-irradiated at 4°K. The results, though clearly showing q-dependent defect-phonon perturbation effects, could not be explained entirely by simplified calculations for the <100> split interstitial. A 300°K anneal removed the radioinduced line broadening and frequency shifts but only ~50% of the additional peak structure, which was completely removed only after an 800-K anneal. (AIP)

CERAMICS, CERMETS, AND REFRACTORIES

9023 (CNLM—3871) Reactor program description of tasks for period May 1, 1961—June 30, 1965. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1965. Contract AT(30-1)-2789. 195p. Dep. NTIS $7.50.

Research activities devoted to development of compact Li-cooled reactors are summarized. Research results are presented in sections on reactor experiment design, reactor development, reactor shield development, primary system development, secondary system development, auxiliary systems development, control system development, instrument development, materials development, physics development, fuel material irradiation for PWAR-16, component irradiation, operation evaluation, reactor test facility design, test facility construction, fuel element fabrication, reactor fabrication, shield fabrication, primary and secondary coolant system for PWAR-16, auxiliary systems fabrication, operation of PWAR-16 and component fabrication for PWAR-18. (JRD)

9024 (COO—1140-217) High temperature chemistry. Progress report, 1 November 1974—31 October 1975. Gilles, P.W. (Kansas Univ., Lawrence (USA). Dept. of Chemistry). 31 Oct 1975. Contract E(11-1)-1140. 17p. Dep. NTIS $3.50.

Activities are described under the topics of education; publications and talks;research progress highlights; space and facilities; level of activity; and miscellaneous. Current research is reported for the high temperature thermodynamics and vaporization of the titanium oxides, the vaporization of the rare-earth borides, the phase studies on the Zr-Nb-O system, the studies on high-molecular weight inorganic species, and the kinetic studies on high-temperature vaporization processes. (auth)

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 8303, 8304

9025 (KFK—2139) Preparation of TiC single crystals. Scheerer, B.; Fink, J.; Reichardt, W. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Kernphysik). Jul 1975. 18p. (In German). INIS.

6 figs.; 2 tabs.; 11 refs.

TiC single crystals were prepared by vertical zone melting for measurements of the phonon dispersion by inelastic neutron scattering. The influence of the starting material and of the growing conditions on the growth of the crystal were studied. The crystals were characterized by chemical methods, EMX and neutron diffraction. It was possible to grow single crystals with a volume of up to 0.6 cm³ and mosaic spread of less than 0.4°. (DE)

9026 (TID—26943) Interpretation of hot pressing kinetics by densification mapping techniques. Notis, M.R.; Smoak, R.H.; Krishnamachari, V. (Lehigh Univ., Bethlehem, Pa. (USA)). 1974. 15p. Dep. NTIS $4.50.

Interpretation of the kinetics of final stage hot pressing has been accomplished through the use of deformation (or "densification") mapping methods. Creep relations, modified to account for the presence of porosity and for constrained dies, were used to model the pressure-sintering densification rate behavior. These relations are displayed graphically such that boundaries delineate the regions in which any densification mechanism is dominant, and where contours of constant densification rate or constant stress exponent may be compared to experimental values.

Examples are shown for the densification of cobalt monoxide. This method, and subsequent manipulation of the computer generated data, enables the quantitative analysis of hot-pressing kinetics during final stage densification under conditions where either linear-viscous or multimechanism plastic flow is observed. (auth)

9027 (UCRL—77844) **Free abrasive grinding for precision optics.** Brown, N.; Prochnow, E.; Blachman, R.; Whistler, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Feb 1976. Contract W-7405-Eng-48. 6p. (CONF-760219—2). Dep. NTIS $3.50.

From Workshop on optical fabrication and testing; San Mateo, California, United States of America "USA" (27 Feb 1976).

A brief summary of the basic principles of free abrasive grinding is presented along with a description of the practice at the LLL optics fabrication shop. Complete data on the process are almost nonexistent. The data correlations used at LLL are presented with the caution that these have been produced for LLL shop practice and have not had the exhaustive cross checking required for data in a scientific publication.

9028 (ORNL-tr—4073) **Method for making SiC coatings on fissile or fertile materials by pyrolysis of silico-organic compounds.** Drittler, K.; Luleich, H. 15 Jun 1972. Translated by M. Gerrard of German Patent 1,571,500. 4p. Dep. NTIS $4.25.

A method for making Si—C coatings on fertile or fissile substances by pyrolysis of a silico-organic compound at temperatures greater than about 1000°C is described. The silico-organic compound is a halogen-free organo-silane with SiC, SiH, or Si—Si bonds and the pyrolysis takes place in one or two steps, the first of which is at about 300 to 600°C. The pyrolysis is carried out in an inert or reducing oxidizing atmosphere or in a high vacuum. (auth)

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 8945

9029 (ORNL-tr—4062) **Structural relations of some important metal nitrides.** Robitsch, J. Translated by M. Gerrard from *Mitteilungsbl., Abt. Mineral. Landesmus. Joanneum;* **1/2**: 86-91(1967). 6p. Dep. NTIS $3.50.

Detailed x-ray data on two metal nitrides, (Cr, Fe)$_3$N/sub 1 - x/, are presented. In the discussion it is shown that numerous known metal nitrides of the composition M_2N to M_4N (M = Cr, Fe, Co, Ni) can be represented as M_2N/sub 1 - x/ with lattice structural defects. Thus there is a real, clearly expressed, and natural ordering in the metal nitrides. (auth)

9030 (UCRL-Trans—10755) **Interaction of titanium with a high-alumina ceramic.** Zhmud, E.S.; Shmelev, A.E.; Metelkin, I.I. Translated from *Izv. Akad. Nauk SSSR, Neorg. Mater.;* **9**: No. 10, 1798-1801(1973). 9p. Dep. NTIS $3.50.

Products formed in the interaction of Ti and alumina ceramic were investigated. It was found that the products of the interaction of titanium with a high-alumina ceramic are distributed in layers in the metallic part of the joint. The number, thickness, structure, microhardness, and composition of these layers depend on the temperture. In joints made at 1150 to 1450°C two layers are formed near the ceramic: first an intermetallic compound TiAl containing some oxygen and then, further away from the ceramic, a Ti(Al, O) solid solution. At 1550 to 1660°C only the Ti(Al, O) solid solution is formed in this region. The middle part of the metal is a solid solution Ti(O, Al) independently of the joint-preparation temperature. No titanium oxides, subcompounds Ti--O and Ti--Al, or free aluminum could be detected in the joints investigated. (auth)

9031 Growth of single-crystal Mn_2SiO_4 (tephroite) by Czochralski and edge-defined film-fed (EFG) techniques. Finch, C.B.; Clark, G.W.; Kopp, O.C. (Oak Ridge National Lab., TN). *J. Cryst. Growth;* **29**: 269-272(1975).

Optically transparent single crystals of Mn_2SiO_4 (tephroite) were grown by the Czochralski method in sizes up to 1 cm diameter by 3 cm length. Growth was achieved from melts contained in platinum crucibles at 1315 +- 5°C under an atmosphere of moist argon—4 percent H_2 (p/sub o_2/ approximately equal to 10^{-10} atm). Samples were also prepared by the edge-defined film-fed growth method (EFG), which confirmed the importance of maintaining a 2:1 $MnO:SiO_2$ melt stoichiometry to obtain the optimum crystal quality. The resulting crystals were characterized by x-ray diffraction and optical methods. Mn_2SiO_4 is transparent to infrared radiation to 5 μm, and appears rose-colored to transmission in the visible. (auth)

9032 Additive and impurity distributions at grain boundaries in sintered alumina. Johnson, W.C. (Ford Motor Co., Dearborn, MI); Stein, D.F. (Ford Motor Co., Dearborn, MI). *J. Am. Ceram. Soc.;* **58**: No. 11-12, 485-488(1975).

Additive and impurity distributions at grain boundaries in sintered Al_2O_3 were determined using a scanning Auger microprobe, transmission electron microscopy, metallography, and electron probe analysis. The results indicated that Ca was present uniformly at the boundaries as a segregant, whereas the Mg or Ni levels observed resulted from nonequilibrium spinel particles. The Ca concentrations were consistent with equilibrium segregation theory and followed an equilibrium segregation isotherm. (auth)

9033 Stable and metastable equilibria in the system SiO_2—Al_2O_3. Aksay, I.A.; Pask, J.A. (Lawrence Berkeley Lab., CA). *J. Am. Ceram. Soc.;* **58**: No. 11-12, 507-512(1975).

Concentration profiles of Al_2O_3 in diffusion couples made from sapphire and fused silica were used to determine the stable equilibrium phase diagram of the system SiO_2—Al_2O_3. The intermediate compound mullite, $3Al_2O_3.2SiO_2$, melts incongruently at 1828 +- 10°C; its stable solid-solution region ranges from 70.5 to 74.0 wt percent Al_2O_3 below 1753°C and from 71.6 to 74.0 wt percent at 1813°C. The microstructures of diffusion zones and heat-treated specimens also indicate the incongruency of mullite. Additional information is given for 3 metastable systems: SiO_2-Al_2O_3 in the absence of mullite, SiO_2-ordered-mullite in the absence of alumina, and SiO_2-disordered mullite in the absence of alumina. Under metastable conditions, ordered mullite melts congruently at approximately 1880°C and its solid-solution range extends up to approximately 77 wt percent Al_2O_3. The solid-solution range of disordered mullite extends to approximately equal to 83 wt percent Al_2O_3 with an estimated congruent melting temperature of approximately 1900°C. The existence of metastable systems is associated with superheating of mullite above the incongruent melting temperature and with nucleation of alumina and mullite in supercooled aluminum-silicate liquids. (auth)

9034 One-band density of states for various fourfold-coordinated random networks with periodic boundary conditions. Guttman, L. (Argonne National Lab., IL). *Phys. Rev., B;* **11**: No. 2, 764-766(15 Jan 1975).

Three different types of random networks were generated by computer simulation, starting from crystalline arrangements. All are perfectly fourfold coordinated, and satisfy periodic boundary conditions. The valence-band densities of electronic states of the various types are far from featureless and can clearly be distinguished from each other. (auth)

9035 Origin and frequency dependence of nonlinear optical susceptibilities of glasses. Hellwarth, R.; Cherlow, J.; Yang, T.T. (Univ. of Southern California, Los Angeles). *Phys. Rev., B;* **11**: No. 2, 964-967(15 Jan 1975).

The frequency dependence of the nonlinear optical susceptibilities of fused quartz and four other glasses were determined along with the relative contributions of electronic and nuclear mechanisms to their nonlinear optical indices. This is the first such determination in solids. The method has been to analyze the absolute measurement of ordinary differential Raman-scattering cross sections in conjunction with the coefficients for intensity-induced polarization changes measured by Owyoung [IEE J. Quantum Electron. 9:1064(1973)] in the same glasses. (auth)

9036 Evidence for order—disorder in PuC/sub 0.80/ at low temperatures through specific-heat measurements. Sandenaw, T.A. (Los Alamos Scientific Lab., N.Mex. (USA)). *J. Nucl. Mater.;* **57**: No. 2, 145-150(Aug 1975).

Extreme dips, which are seldom reproducible, occur in specific heat versus temperature curves of PuC/sub 0.80/. Heat evolution, which appears to be the source of the dips, occurs in several strongly pronounced stages. This can be interpreted as evidence for both an antiphase-ordered structure and a martensite-like behavior. Attention is called to microscopy results for another nonstoichiometric NaCl-type carbide, having essentially the same metal atom/carbon atom ratio, where a faulted structure, crystallographic shear, and interstitial ordering of carbon voids are shown to exist. It is suggested that there is a preference for an ordered accommodation of excess vacancies (carbon voids) in PuC/sub 0.80/ into a long period superlattice as has been shown to occur with V_6C_5(VC/sub 0.83/). It is also speculated that this form of structural accommodation, which is similar to "crystallographic shear", is the source of a specific-heat behavior, which is equivalent to that of a quenched martensite. (NL)

9037 Vibrational spectra of spinels with cation ordering on the octahedral sites. Keramidas, V.G.; Deangelis, B.A.; White, W.B. (Pennsylvania State Univ., University Park). *J. Solid State Chem.;* **15**: No. 3, 233-245(Nov 1975).

Infrared and Raman spectra are reported for compounds with 1:1, 1:3, and 1:2 mixed ordering on the octahedral sites of the spinel structure. The spectra of the superstructures are complex with many more bands observed than occur in the parent spinel

structure, although less than were predicted by group theoretical analysis. A qualitative interpretation of the spectra can be made through the large Brillouin zone concept. (auth)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 8644

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 9050, 10017

9038 (BARC—803) **Resistivity changes in CrS and FeS_2 at high pressures.** Vaidya, S.N.; Karunakaran, C.; Gokhale, A.S.; Karkhanavala, M.D. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 15p. Dep. NTIS (US Sales Only) $3.50.

A bridgman anvil apparatus was designed and set up for electrical resistivity measurements up to 80 kb. The apparatus was calibrated against the Bi I-III, Te I-II and Bi V-VII transitions, and resistivities of the polycrystalline CrS and FeS_2 were determined up to 70 kb. The resistance of both the sulphides showed a monotonic decrease at high pressures. (auth)

9039 (BNL—20600) **Spin-wave and critical scattering of neutrons from cobalt disulfide.** Iizumi, M.; Lynn, J.W.; Ohsawa, A.; Ito, H. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 6p. (CONF-751209—17). Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The triple-axis neutron scattering technique has been used to measure the temperature dependence of the spin-wave and critical scattering below T/sub c/(=120°K) in the metallic ferromagnet CoS_2. The spin-wave dispersion relations at small propagation vectors (vertical bar q vertical bar less than or equal to $0.3A^{-1}$) can be described by dirac constant $\omega = Dq^2$-Eq^4 with D of about 110 MeV-A^2 and E/D of 1 approximately $2A^2$ at 78°K, with a small anisotropy observed in the different symmetry directions of the crystal. At small q, D is found to renormalize as (1-T/T/sub c/)/sup/β/ with $\beta = 0.24$. Some indication of a triple-peaked structure in the scattering spectrum was observed immediately below T/sub c/. (auth)

9040 (CALT—822-79) **Further evidence for the T^{-}1/2 singularity in amorphous Kondo alloys.** Hasegawa, R. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Dec 1975. Contract AT(04-3)-822. 11p. Dep. NTIS $3.50.

A T/sup -1/2/ variation of resistivity with temperature near T = 0 is found in rapidly quenched amorphous Ni—Pd—P alloys containing up to at.percent Mn, providing further evidence for the existence of this new singularity. It is argued that the new resistivity term arises from interference between multiple scattering of conduction electrons by atoms in magnetic and nonmagnetic states and is observed as a consequence of a short electron mean free path and breakdown of conservation of electron momenta in amorphous alloys. (auth)

9041 (CEA-CONF—3092) **Measurement of specific heat of pure and vanadium doped Al_2O_3 monocrystals at low temperature.** Lagnier, R.; Villedieu, M.; Bonjour, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). 1975. 6p. (In French). INIS.

From Meeting on calorimetry and thermal analysis; Grenoble, France (22 May 1975).

Within the scope of a study on charge transfer mechanisms in vanadium doped Al_2O_3 monocrystals, the absolute concentrations of V^{3+} ions were determined using Schottky's anomaly of ions, the maximum of which lies around 5K. (FR)

9042 (JUL—1233) **Field-induced magnetic phase transitions in hematite (α-Fe_2O_3)-single crystals. A neutron diffraction investigation.** Hoenigschmid, J. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung). Aug 1975. 102p. (In German). Dep. NTIS (US Sales Only) $5.50.

Thesis. Submitted to Bonn Univ.

The magnetic structure of single crystals of hematite was studied in magnetic fields above and below the second magnetic phase transition (Morin-transition) by means of elastic neutron diffraction. The dependence of the phase transition on temperature (from 2200 to 265°K) and on field strength (up to 70 kG) yields a value of 9.6 x 10^5 erg/cm^3 for the latent heat of the Morin-transition. The results are compared with the phenomenological theory of Dzyaloshinskii. In experiments in which the field is applied in two different directions in the trigonal basal plane (parallel and perpendicular to one of the twofold axis) trigonal domains above the Morin-transition are found. These domains disappear at fields higher than 10 kG. Below the Morin-transition two domains are found when an external field is applied. The two magnetization directions have a mirror plane, which is given from the direction of the external magnetic field and the trigonal axis. The moments remain in a plane perpendicular to the field during the field-induced movement. The superconducting magnet and the gas flow insert cryostat are described. (auth)

9043 (LA—6037-MS) **Review of thermal expansion and density of uranium and plutonium carbides.** Andrew, J.F.; Latimer, T.W. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. Contract W-7405-Eng-36. 17p. Dep. NTIS $4.00.

The published literature on linear thermal expansion and density of uranium and plutonium carbide nuclear fuels, including UC, PuC, (U,Pu)C, U_2C_3, Pu_2C_3, and $(U,Pu)_2C_3$, is critically reviewed. Recommended values are given in tabular form and additional experimental studies needed for completeness are outlined. 16 tables, 52 references. (auth)

9044 (SAND—75-0338) **Determination of electromagnetic absorption parameters by reflection measurements.** Vittitoe, C.N. (Sandia Labs., Albuquerque, N.Mex. (USA)). Sep 1975. Contract AT(29-1)-789. 44p. Dep. NTIS $4.00.

The method described is for determining the electromagnetic absorption parameters of a material by measuring the optical reflection from a thick sample. With linearly polarized incident light (both perpendicular to and parallel to the plane of incidence), the ratio of the reflected intensities at three or more angles of incidence offers promise for determining the complex index of refraction of a material for a broad range of parameter values. The method may be applicable to molten materials, such as UO_2, where high temperatures cause corrosion and containment difficulties. A method is given for extending the data to neighboring frequencies. Use of the method was successful for all portions of the complex index of refraction plane except for small values of the extinction coefficient. (auth)

9045 **Thermodynamic stability and physical properties of metallic sulfides and oxysulfides.** Gschneider, K.A. Jr. (Ames Lab., IA). pp 159-177 of In Sulfide inclusions in steel. deBarbadillo, J.J. (ed.). Metals Park, OH; American Society for Metals (1975).

Thermodynamic data on metallic sulfides are reviewed. Other properties such as crystal structure and melting points, which affect the behavior of sulfides and oxysulfides are also examined. Information is included on sulfide inclusions in steel, stability of sulfides, sulfide melting points, and mechanical properties of sulfides. (JRD)

9046 **ZrO_2-Pt interface reactions.** Rhee, S.K. (Bendix Corp., Southfield, MI). *J. Am. Ceram. Soc.*; **58**: No. 11-12, 540(1975).

The reactions between ZrO_2 and Pt in H_2 at 800°C were investigated. It was found that the debonding of Pt electrodes on the ZrO_2 galvanic cell in a reducing atmosphere is caused by the reaction of Pt with ZrO_2, forming a solid solution or intermetallics; this type of reaction is also observed for the cubic stabilizer CaO as well as for the SiO_2 impurity present in ZrO_2. Caution must be exercised when Pt thermocouples are used in contact with oxides in a reducing atmosphere. (auth)

9047 **Thermal expansion of mixed-alkali germanate glasses.** Shelby, J.E. (Sandia Labs., Livermore, CA). *J. Appl. Phys.*; **46**: No. 1, 193-196(Jan 1975).

Thermal expansion measurements were made for several series of $Na_2O.K_2O.GeO_2$ glasses, for one series of $Na_2O.Rb_2O.GeO_2$ glasses, and for one series of $Na_2O.Cs_2O.GeO_2$ glasses. Negative deviations from additivity were observed in the critical and deformation temperatures in every case, with the deviations increasing with total alkali concentration. Positive deviations from additivity were noted in the thermal expansion coefficients of the Na_2O + K_2O and Na_2O + Rb_2O glasses, whereas the Na_2O + Cs_2O glasses exhibited negative deviations from additivity. Changes in the coordination of the network forming elements had no effect on the nature of the deviations from additivity. Since these deviations seem so similar to those observed in other alkali-free glass systems, the common usage of the term mixed-alkali effect to describe their occurrence is questioned. (auth)

9048 **Electromechanical response of PZT 65/35 subjected to axial shock loading.** Lysne, P.C.; Bartel, L.C. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; **46**: No. 1, 222-229(Jan 1975).

This theoretical and experimental investigation deals with the electromechanical response of a shock-loaded ferroelectric ceramic material. Quartz gage and voltage-mode techniques were used to characterize the mechanical and electrical responses, respectively, of PZT 65/35 to approximately 80 kbar. Below approximately 20 kbar the wave propagation was dispersive, whereas step shocks were steady between approximately 20 kbar and the

approximately 36-kbar Hugoniot elastic limit. Above 36 kbar the final stress states were reached asymptotically and are believed to be steady. The electrical response was complicated by the ferroelectric-to-paraelectric phase transformation at 60 +- 3 kbar and the kinetics of the change in polarization. To investigate this latter effect, a kinetic model is developed which gives good agreement with experimentally determined voltage responses. (auth)

9049 Superconducting properties of thin film niobium carbonitrides on carbon fibers. Pike, G.E. (Sandia Labs., Albuquerque, NM); Mullendore, A.W.; Schirber, J.E.; Napier, J. *IEEE Trans. Magn.*; **MAG-11**: No. 2, 185-188(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The characteristics of a new superconducting wire material, consisting of a 7 μm carbon filament substrate thinly coated with niobium carbonitride, are reported. These filaments are coated (approximately 1000 at a time as a yarn) by a co-CVD process in which the desired carbonitride is deposited as a compound. Several coating compositions from NbC to $NbC_{.75}N_{.15}$ were studied. At each composition several coating thicknesses from 300 to 3000 A were prepared. Although the present coating compositions are not near $NbC_{0.3}N_{0.7}$, which has previously been determined as optimum for this pseudobinary system, we nevertheless have obtained excellent superconducting properties. Zero-field critical current densities of 2 x 10^6 A/cm^2 in the coating have been obtained, and there is no discernable ac loss at frequencies up to 50 kHz. In addition to the superconducting measurements, chemical x-ray diffraction, and electron microscopic analyses on the coated filaments were also performed. (auth)

9050 Hyperstoichiometric regions as potential short-circuit paths for oxygen diffusion in the unrestructured regions of irradiated UO_2 and $(U,Pu)O_2$ nuclear fuel elements. Brandt, W.W. (Wisconsin Univ., Milwaukee (USA). Dept. of Chemistry); Seils, C.A.; Johnson, C.E. (Argonne National Lab., Ill. (USA)). *J. Nucl. Mater.*; **57**: No. 2, 212-220(Aug 1975).

The relative concentrations of oxygen in the unrestructured regions of several irradiated fuel elements of the composition (U,Pu)O/sub 2-x/ have been measured by electron microprobe methods. Fluctuations were found between closely spaced points, which indicate that hyperstoichiometric diffusion paths may well be formed and may greatly facilitate oxygen transport from the interior to the edge of the elements. In some cases, average expected radial oxygen gradients were computed for the unrestructured regions, using literature data. The results indicate that a very small excess of oxygen, above the stoichiometric amount, is sufficient to account for the observed transport. (NL)

9051 High temperature vaporization and thermodynamics of the titanium oxides. IX. Fragmentation of TiO_2^+. Conrad, B.R.; Bennett, J.E.; Gilles, P.W. (Univ. of Kansas, Lawrence). *J. Chem. Phys.*; **63**: No. 12, 5502-5503(15 Dec 1975).

The fragmentation of TiO^+_2 during the high temperature vaporization of TiO_2 was measured by mass spectrometry. The TiO^+/TiO^+_2 intensity ratios, their trends with time, and the TiO^+2 fragmentation of less than 2.5 +- 1.3 percent are all consistent with the known vaporization behavior of the Ti--O system. (JSR)

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 8165, 9117

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 8553, 8646

9052 (ORNL—5096) **Irradiation behavior of Eu_2O_3 in EBR-II experiment BICM-1.** Martin, M.M.; Pasto, A.E.; Donnelly, R.G. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. 38p. AT.

Europium oxide is an excellent candidate neutron absorber material for fast nuclear reactors. It can be fabricated readily into dense shapes, has a high nuclear worth that it retains during burnup, and does not generate gas and tritium when it captures neutrons. To determine its irradiation behavior, eight Eu_2O_3 test pellets of 7.6 mm diam by 7.6 mm high (0.3 by 0.3 in.) were fabricated to densities in excess of 90 percent of theoretical and irradiated in the instrumented BICM-1 experiment in EBR-II to a fluence of 6 x 10^{26} n/m^2 (greater than 0.11 MeV) at about 700°C (1292°F). Postirradiation examination showed Eu_2O_3/Type 316 stainless steel and Eu_2O_3/W—Re alloy to be compatible material systems and that Eu_2O_3 had retained most of its initial crystallinity. Hot-pressed cubic Eu_2O_3 pellets densified as a consequence of irradiation-induced sintering; their diameters decreased 0.5 percent and their edges chipped appreciably. Monoclinic Eu_2O_3 pellets dedensified from a combination of intergranular microcracks and both axial and circumferential macrocracks; their diameters increased 3.9 percent and 3.6 percent, respectively, for hot-pressed and sintered products. (auth)

9053 Far-infrared EPR of Al_2O_3:Mn^{3+} and γ-irradiated ruby. Aurbach, R.L.; Richards, P.L. (Univ. of California, Berkeley). *Phys. Rev., B;* **12**: No. 7, 2588-2595(1 Oct 1975).

The far-infrared spectra of four samples of Mn-doped Al_2O_3 were measured in the frequency range from 3 to 30 cm^{-1} in applied magnetic fields up to 55 kG using the techniques of Fourier-transform spectroscopy. Several absorption lines, which are attributed to Mn^{3+} ions, were observed for fields oriented both parallel and perpendicular to the c axis. Polarization measurements established that the lines were due to electric dipole transitions. The temperature dependence of the lines was studied in the range from 1.3 to 20°K. Both ground- and excited-state transitions were studied. The ground state was found to be a singlet. Ground-state transition intensities were found to be magnetic field dependent. A crystal-field theory was developed which successfully describes the low-lying states. The Jahn-Teller interaction, which is known to be important for this ion, is included in the theory only in the approximation that its effect is to quench the strengths of various terms in the Hamiltonian. The empirically determined trigonal field and spin-orbit quenching parameters are approximately 0.6 and 0.1, respectively. Excellent agreement with experiment was obtained for the ground-state transitions. The less good agreement obtained for excited-state transitions reveals weaknesses in the model. A γ-irradiated ruby was also studied and very weak absorption lines believed due to Cr^{3+} and Cr^{4+} were observed. (auth) Cr^{4+} re observed. (auth)

COMPOSITE MATERIALS

9054 (AERE-R—8161) **Effect of a two stage curing schedule on the fiber loading and transparency of unidirectionally wound glass fiber/epoxy resin plates.** Brown, E. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1975. 10p. Dep. NTIS (US Sales Only) $3.50. UK pounds1.00.

This report describes the effect of changes in a two-stage curing schedule for the resin matrix on the fibre content and transparency of filament-wound glass fiber reinforced epoxy resin plates. It is shown that, in order to minimize the appearance of resin starvation and porosity, the resin matrix must attain a particular degree of viscosity or tackiness prior to final curing in a hot press. This precure stage is also seen to affect the fibre loading, light transmission, property, and transparency of the final composite. Although a wide range of time and temperature is possible for polymerization of the matrix, the curing schedule temperatures for this experiment are fixed at 100 and 150°C respectively whilst time at 100°C is varied. Effect of pressure at the final cure stage shows that fiber loading increases up to an optimum value of 73 percent at 667 psi. (auth)

PREPARATION AND FABRICATION

9055 CVD/PAN felt, carbon/carbon composites. Lieberman, M.L.; Curlee, R.M.; Braaten, F.H.; Noles, G.T. (Sandia Labs., Albuquerque, NM). *J. Compos. Mater.*; **9**: 337-346(Oct 1975).

The preparation and evaluation of a CVD/PAN carbon/carbon frustum are described. The thermal gradient infiltration technique has successfully yielded a matrix composed primarily of the desired rough laminar microstructure. Characterization of the composite includes thermal and mechanical properties as functions of temperature, as well as room-temperature crystallographic parameters. (auth)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 8721

9056 (AERE-R—8217) **Variability of the tensile strength of unidirectional carbon fiber reinforced plastics.** Hitchon, J.W.; McCausland, W.H.; Phillips, D.C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1975. 61p. Dep. NTIS (US Sales Only) $4.50. UK pounds1.50.

Unidirectional CFRP specimens have been made by a variety of wet and dry fabrication techniques including wet lay-up, pultrusion, wet and dry filament winding, and pressed preimpregnated sheet in order to compare the effect of fabrication route on strength. In order to eliminate the effect of fiber variability, the fiber strengths and moduli were monitored throughout the fabrication programme. The composites were tested by standard tensile

and flexural tests, and also by hoop-burst tests. These tests subjected different volumes of composite to stress, and the effect of component size and stress distribution was treated by Weibull statistics. Significant differences in strength resulted from different fabrication routes. In particular high modulus fibers transferred a smaller proportion of their strength into composites than did lower modulus fibers, and significant differences in composite strength were obtained with the two different resins used. The use of Weibull statistics to treat the relationship between strength of hoops and standard tensile specimens was promising, but the behavior of flexural specimens could not be treated satisfactorily in this way. (auth)

9057 (UCRL—77466) **Accelerated test for predicting the lifetime of organic fiber composites.** Chiao, C.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1975. Contract W-7405-Eng-48. 18p. (CONF-750248—1). Dep. NTIS $3.50.

From 3. bienniel AIME symposium on failure modes in composites; Las Vegas, Nevada, United States of America "USA" (22 Feb 1975).

A theoretical model and experimental design for predicting the stress-rupture life of fiber composites are presented. The model is based on the failure mode of organic fiber composites under uniaxial tension. The acceleration involves both temperature and stress, and can be represented by Zhurkov's modified Arrhenius equation. The model will be tested by comparing the predicted lifetime with the known lifetime of a typical composite. (auth)

PHYSICAL PROPERTIES

9058 (ERDA-tr—84) **Thermal contraction of glass fiber reinforced epoxy resins down to the lowest temperatures.** Hartwig, G.; Puck, A.; Weiss, W. Translated from *Kunststoffe;* **64**: (1974). 9p. Dep. NTIS $4.50.

The thermal contraction of glass fiber reinforced epoxy resin was measured from ambient temperature to the temperature of liquid helium on well-balanced angular compounds with two fiber directions of +-0° to +-90° taken symmetrically to the measuring direction. The dependence on the glass fiber component was investigated. Results were compared with theoretical computations; agreement is good. (DLC)

POLYMERS AND PLASTICS

MECHANICAL PROPERTIES

9059 (BDX—613-1345(Rev.)) **Flexible polyurethane .** Salary, J. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1976. Contract AT(29-1)-613. 25p. Dep. NTIS $4.00.

Flexible polyurethane foam systems with different densities and load-bearing properties have been developed for use in packaging applications. A flexible foam formulation, Number 092674-1, has been designated BKC 45301 according to Material Standard 2170658. (auth)

9060 (UCID—16982) **Equation of state for polymethylmethacrylate.** Steinberg, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Dec 1975. Contract W-7405-Eng-48. 13p. Dep. NTIS $3.50.

A Grueneisen equation of state, valid to approximately 2 Mbar, is presented for polymethylmethacrylate. Calculations of experimental results using this equation agree favorably with the experimental data. (auth)

PHYSICAL PROPERTIES

9061 (BDX—613-1396) **Dielectric analysis of an epoxy preimpregnated material.** Walker, J.M. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1976. Contract AT(29-1)-613. 29p. Dep. NTIS $4.00.

The introduction to the principles of dielectric analysis as it relates to the cure mechanism of a preimpregnated material is given. The relationship between dielectric behavior and polymer response is also discussed. Dissipation versus time and temperature curves are presented and their relationship to production cycles and extent of cure analysis is shown. (auth)

9062 (BDX—613-1422(Rev.)) **Feasibility study for producing high-density polystyrene bead foam .** Swoboda, R.C. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1976. Contract AT(29-1)-613. 28p. Dep. NTIS $4.00.

It has been determined that the production of high-density polystyrene bead foam (PSBF) within a density range of 0.20 to 0.50 g/cm^3 is feasible, using existing production equipment. The required processes have been developed for steam pre-expansion, pneumatogen depletion, and molding to yield material with acceptable density uniformity. The mechanical properties for foam at selected density levels have been determined. (auth)

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 8747, 9055

STRUCTURE AND PHASE STUDIES

9063 **KBr—CuBr and NaBr—CuBr phase diagrams.** Biefeld, R.M. (Sandia Labs., Albuquerque, NM). *Mater. Res. Bull.;* **10**: No. 11, 1151-1156(Nov 1975).

The phase diagram of KBr—CuBr was reinvestigated. It consists of a peritectic and a eutectic. The peritectic is the formation of the intermediate compound, K_2CuBr_3. Its structure is orthorhombic and isomorphous with K_2CuCl_3 with a = 12.546(4), b = 13.183(3) and c = 4.322(1) A. A rationale for the structure formed is given. The NaBr—CuBr system contains a single eutectic and no intermediate compounds. (auth)

9064 **Melting properties and ultrasonic velocity of nitrogen to 20 kbar.** Mills, R.L.; Liebenberg, D.H.; Bronson, J.C. (Los Alamos Scientific Lab., NM). *J. Chem. Phys.;* **63**: No. 9, 4026-4031(1 Nov 1975).

Simultaneous measurements of the longitudinal sound velocity and relative volume were made on freezing nitrogen at pressures up to 20 kbar in a piston-cylinder apparatus. Results in both the fluid and solid phases were combined with data at lower pressures from the literature to derive equations giving the melting properties of nitrogen at high pressure. The solid in equilibrium with the fluid is apparently β-N_2 (hcp) throughout the experimental range. An estimate was made of the transverse sound velocity in β-N_2 at high pressure. Analysis of the total entropy change on melting shows that the entropy component due to disordering of the molecules from solid to fluid nitrogen has a fairly constant value of about ln 1.7 along the entire melting curve. There is no indication that the melting curve will terminate in a critical point. (auth)

PROPERTIES

REFER ALSO TO CITATION(S) 8537, 8969, 8972, 8975, 8976, 9163

9065 (CEA-CONF—3093) **The thermal properties of NiS.** Brusetti, R.; Coey, J.M.D.; Bonjour, E.; Lagnier, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). 1975. 7p. (In French). INIS.

From Meeting on calorimetry and thermal analysis; Grenoble, France (22 May 1975).

Calorimetric measurements were carried out between 4 and 300°K on samples of Ni(1-delta)S, the deviation delta from stoichiometry lying between 0.00 and 0.05. (FR)

9066 (UCRL-Trans—10739) **Properties of rigid polyurethane foams of microporous structure.** Ostrysz, R.; Penczek, P.; Skrzewiecki, J. Translated from *Polimery;* **18**: 299-302(1973). 12p. Dep. NTIS $3.50.

The mechanical properties of polyurethane foams were investigated. It was found that the apparent density of polyurethane foams decreases with increasing amount of water in the starting mixture. The compressive and impact strengths increase with increasing apparent density; the water absorption and high-temperature shrinkage are also increased. The introduction of the polyesterol Poles 50/23 (with greater molecular weight and smaller branching) in place of part of the polyesterol Poles 210/24 causes an appreciable increase in the impact strength of a simultaneous fall of compressive strength. A considerable decrease of compressive strength occurs when the addition of polyesterol Poles 50/23 exceeds 15%, and such additions are therefore undesirable. A side effect of increasing the elasticity with an unchanged content of water, catalysts, and foaming regulator in the starting mixture is a decrease in the apparent density; the water absorption and the shrinkage at elevated temperatures remain practically unchanged. (auth)

9067 **Reproducibilities of some physical properties of MgF_2.** Bailey, D.M.; Calderwood, F.W.; Greiner, J.D.; Hunter, O. Jr.; Smith, J.F.; Schiltz, R.J. Jr. (Ames Lab., IA). *J. Am. Ceram. Soc.;* **58**: No. 11-12, 489-492(1975).

Optical-quality MgF_2 specimens selected to represent varying levels of fabrication stresses and impurities were examined to determine their elastic moduli, thermal expansions, and thermal conductivities. These properties proved to be insensitive to the variations in impurities among the samples. The elastic moduli were also insensitive to the variations in residual strain. Any sensitivity to residual strain was masked, in the case of thermal conductivity measurements, by the fracture of highly strained specimens during sample manipulation and, in the case of thermal expansion measurements, by crushing the specimens to powder before measurement. (auth)

9068 Effect of impurities on the high-temperature creep of LiF. Ruoff, A.L.; Narayan Rao, C.V.S. (Cornell Univ., Ithaca, NY). *J. Am. Ceram. Soc.;* **58**: No. 11-12, 503-506(1975).

Creep of undoped and Mg-doped single-crystal LiF was investigated in the range 650 to 750°C. The behavior observed is similar to that of pure metals. The strain rate was proportional to (stress)/sup n/, with n = 5.0 +- 0.4 at T = 650 and 700°C and n = 3.60 +- 0.2 at T = 750°C; n was independent of dopant level. The activation energies for creep were 2.09 +- 0.08 eV for undoped specimens in the intrinsic range and 2.60 +- 0.08 eV for doped specimens in the extrinsic range. A lower creep rate was found in doped samples than in undoped samples. However, the creep strain rates observed in heavily doped samples were not inversely proportional to the dopant level. The observations for pure LiF are explained on the basis of vacancy diffusion through the lattice. A model based on dopant cation vacancy complexes and binding of dopant to charged dislocations is presented to explain the behavior of the doped specimens. (auth)

9069 Creep behavior of ceramic solid-solution alloys. Mohamed, F.A.; Langdon, T.G. (Univ. of Southern California, Los Angeles). *J. Am. Ceram. Soc.;* **58**: No. 11-12, 533-534(1975).

For NaCl-KCl solid solutions, the shape of creep curves was consistent with that anticipated for class II alloy behavior. For class II alloys the stress component is approximately 3, there is little or no instantaneous strain on application of load, the creep curve exhibits little or no primary creep, the steady-state creep rate appears to be independent of the stacking-fault energy of the alloy, and subgrains either are not formed during creep, or, if formed, are not very extensive. (WDM)

9070 (ERDA-tr—86, pp 40-48) **Thermomechanical low temperature investigations on filled and unfilled epoxides.** Hartwig, G. (Institute for Experimental Nuclear Physics, Karlsruhe, Ger.). Jan 1975. Translated from German report.

In Reports of the Nuclear Research Center, Karlsruhe. 7th annual publication.

An overview of measuring methods and test results on filled and unfilled epoxides is presented. Discussions are included on thermal contraction, heat conductivity, specific heat, and mechanical stability. (JRD)

9071 Dynamic tensile strength of glycerol. Carlson, G.A.; Levine, H.S. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.;* **46**: No. 4, 1594-1601(Apr 1975).

By use of a tensile stress wave 0.1 to 0.4 μsec in duration, generated by pulsed electron-beam energy deposition, the dynamic tensile strength (TS) of glycerol was determined in the 220 to 350°K temperature range. The TS curve is clearly divided into high- and low-temperature segments at about 262°K. Above this temperature, the TS decreases uniformly from 250 MPa (2.5 kbar) to 34 MPa at 350°K and failure appears to occur by void nucleation and growth. The experimental results are explained by a theory of homogeneous bubble nucleation which takes into account the non-steady-state nature of the experiment. Below the transition temperature, the TS is constant at about 250 MPa and failure is believed to occur by crack nucleation and growth. (auth)

9072 Comparison of experimental and calculated elastic-plastic wave profiles in LiF. Asay, J.R.; Hicks, D.L.; Holdridge, D.B. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.;* **46**: No. 10, 4316-4322(Oct 1975).

Precursor decay in pure LiF was examined using a laser interferometer technique to measure particle velocity at the rear surface of specimens with thicknesses of about 1.1 and 3.5 mm. For an initial impact stress of about 2.5 GPa (25 kbar), the measured precursors were found to be essentially sharp shocks with rise times on the order 1-2 ns and with amplitudes of 0.25 and 0.24 GPa, respectively. The complete wave profiles measured experimentally were fit with a characteristic code, employing the method of shock fitting. Good agreement between experimental and calculated results is obtained using a constitutive model based on the nucleation of dislocations at the shock front and subsequent expansion in the form of circular loops. (auth)

9073 Crystal-field analysis for the susceptibility of lanthanide compounds of the form Cs_2NaRCl_6. Dunlap, B.D.; Shenoy, G.K. (Argonne National Lab., IL). *Phys. Rev., B;* **12**: No. 7, 2716-2724(1 Oct 1975).

Crystal-field theory is used to discuss susceptibility data for the compounds Cs_2NaRCl_6 where R = Ce, Nd, Tb, Dy, Ho, Tm, and Yb. These materials have an octahedral coordination for the lanthanide ion which remains undistorted even at low temperatures. A combined analysis of all the susceptibility data provides the crystal-field interaction parameters $A_4[r^4] = 254[r^4]$K nd $A_6[r^6] = 4[r^6]$ K with $[r^4]$ and $[r^6]$ in atomic units. The numerical values A_4 and A_6 are independent of the lanthanide ion within experimental error. Attempts to explain these results within a simple point-charge model were unsuccessful. (auth)

9074 Correlation functions in Heisenberg magnetic chains: quantum effects at low temperatures. Mikeska, H.J. (Brookhaven National Lab., Upton, NY). *Phys. Rev., B;* **12**: No. 7, 2794-2802(1 Oct 1975).

A theoretical approach to the one-dimensional isotropic Heisenberg model at low temperatures is presented which uses rotationally invariant combinations of spin operators only and is thus adapted to treat correctly effects resulting from the absence of long-range order in these systems. Analytic expressions for space- and time-dependent spin correlation functions are given for small values of T/JS^2 and $1/S$. The results include an expression for the spin correlation function in the antiferromagnetic ground state and a discussion of changes in line shape, due to quantum effects, for short-wavelength magnons as observed in neutron scattering experiments. (auth)

9075 Time-independent spin correlations in paramagnetic manganese fluoride. Lau, H.Y. (Comitato Nazionale per l'Energia Nucleare, Rome); Tucciarone, A.; Menzinger, F. *Phys. Rev., B;* **12**: No. 7, 2803-2807(1 Oct 1975).

The static susceptibility X (Q) has been measured in MnF_2, by means of neutron scattering, covering extensively the first Brillouin zone of reciprocal space at temperatures between 1.45T/sub N/ and 4.4T/sub N/. Excellent agreement is found with the high-temperature expansions theory of the simple Heisenberg antiferromagnet. (auth)

9076 Mean field and exact results for structual phase transitions in on-dimensional and very anisotropic two-dimensional and three-dimensional systems. Bishop, A.R.; Krumhansl, J.A. (Cornell Univ., Ithaca, NY). *Phys. Rev., B;* **12**: No. 7, 2824-2831(1 Oct 1975).

Previous theoretical descriptions of one-dimensional structural phase transitions are extended to two- and three-dimensional systems. The model has relevance to transitions in ferroelectrics, to highly anisotropic organic and polymeric materials, and possibly to current discussions of nonlinear quantum field theories (following from the analogy between functional integral representations of statistical-mechanical partition functions for continuous fields, and Feynman path-integral formulation of quantum mechanics). (auth)

9077 Temperature dependence of the far-infrared absorption spectrum in amorphous dielectrics. Mon, K.K.; Chabal, Y.J.; Sievers, A.J. (Cornell Univ., Ithaca, NY). *Phys. Rev. Lett.;* **35**: No. 20, 1352-1355(17 Nov 1975).

A study of the temperature dependence of the absorption coefficient in amorphous dielectrics below 10 $cm^{-1}$is the basis of identification of two-level configurations from thermal population changes. It is also found that the anomalous low-frequency modes in glasses consist of widely spaced manifolds of energy levels. (auth)

9078 Pressure dependence of superconductivity and normal conductivity in polymeric sulfur nitride, (SN)/subx/. Gill, W.D.; Greene, R.L.; Street, G.B.; Little, W.A. (IBM Research Laboratory, San Jose, California 95193). *Phys. Rev. Lett.;* **35**: No. 25, 1732-1735(22 Dec 1975).

The hydrostatic pressure dependence of the superconducting transition temperature t/subc/, the critical magnetic field H/subc/$_2$, and the normal-state conductivity of crystalline (SN)/subx/ are reported. Under pressure T/subc/ increases from 0.33degreeK(P=0) to 0.54degreeK(P=9plus-or-minus1 kbar). The increase in T/subc/ is attributed to pressure-induced band structure changes. (AIP)

CORROSION, EROSION, AND DEGRADATION

9079 (RFP-Trans—172) **Experimental research into the reaction of carbon with pyrocarbon.** Nechaev, V.N.; Rogailin, M.I. 1972. Translation of pp 83-88 from Novye metody szhiganiya topliva i voprosy teorii goreniya. 5p. Dep. NTIS $4.50.

Results of an experimental investigation are presented of the reaction of pyrocarbon with carbon dioxide at 1400 to 2400°K, CO_2 concentration of 10 to 100%, and Reynolds numbers of 350 to 5000. The investigation showed that the anomalous character of the temperature dependence of the reaction rate disappears with an increase in the gas flow rate. The following kinetic characteristics of the process have been determined: E = 88 +- 5 kcal/mole; K = 6.15 x 10e/sup -88/RT/; and 0 less than or equal to n less than or equal to 1 for T = 1400 to 2000°K, where E is the activation energy, K the reaction rate, and n the C + CO_2 reaction order. (JRD)

9080 Determination of the oxygen binding site on GaAs(110) using soft-x-ray-photoemission spectroscopy. Pianetta, P.; Lindau, I.; Garner, C.; Spicer, W.E. (Stanford Univ., CA). *Phys. Rev. Lett.*; **35**: No. 20, 1356-1359(17 Nov 1975).

The first steps in the oxidation of GaAs(110) are examined through shifts in the As and Ga 3d levels as a function of oxygen exposure. A large chemical shift is observed in the As 3d levels (about 4 eV) while the Ga 3d levels were shifted by less than 1 eV. This gives direct evidence for oxygen bonding to arsenic at the GaAs(110) surface, and illustrates the change in chemical character which can take place in atoms at the surfaces of compounds. (auth)

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 8670

9081 (CNLM—6139) **Design study: lithium hydride inpile capsule irradiation test.** Ackermann, W. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 9 Feb 1965. 3p. Dep. NTIS $3.50.

Declassified 19 Jan 1976.

A proposal for a design study of an in-pile capsule to be used for irradiation of LiH shielding material is presented. The LiH specimen has 19-9 DL cladding. (JRD)

9082 (SAND—75-8222) **Absorption induced in fiber waveguides by low dose-rate electron and gamma-ray radiation.** Watkins, L.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 22p. Dep. NTIS $3.50.

Comprehensive measurements of absorption versus radiation dose and recovery versus time have been performed in some optical fibers. Results show that the values of radiation-induced absorption are independent of dose rate from 5 x 10^2 to 6 x 10^6 rads/day for total doses to 6 x 10^4 rads. The fibers studied were Corning Low Loss, Schott uv, Crofon, Polystyrene Core and Galileo K2-K irradiated with ^{60}Co gamma-rays and ^{90}Sr beta particles. (auth)

9083 Exciton dynamics in α-particle tracks in organic crystals: magnetic field study of the scintillation in tetracene crystals. Geacintov, N.E.; Binder, M.; Swenberg, C.E.; Pope, M. (New York Univ., NY). *Phys. Rev., B*; **12**: No. 10, 4113-4134(15 Nov 1975).

The mechanisms of scintillation of organic crystals bombarded by α particles are discussed in terms of the current knowledge of exciton dynamics, which has been derived from a study of the photofluorescence of crystals such as anthracene and tetracene. The scintillation of tetracene excited by 4.4-MeV α particles incident in a direction perpendicular to the ab plane has been studied in the presence of external magnetic fields (0 to 4000 G) and compared with the scintillation of crystalline anthracene. At 298°K, the magnetic field effect on the total scintillation yield is (+2.5 +- 0.5) percent in tetracene and displays a typical fissionlike (fission of one singlet exciton into two triplets) dependence. At low temperatures when fission is suppressed, a fusionlike dependence (reverse of fission) appears with a (-4 to -5) percent effect at 4000 G at 148°K. In anthracene, the fusionlike dependence is observed with a (-4 to -5) percent effect at 4000 G at 148°K. In anthracene, the fusionlike dependence is observed at all temperatures in the range studied (148 to 298°K). Using appropriate kinetic equations, expressions are derived for the prompt (L/sub P) and delayed (L/sub D/) components of the total scintillation yield L = L/sub P/ + L/sub D/. These expressions describe the temperature and magnetic field dependence of L, which arises because of the temperature and magnetic field dependence of the exciton fission and fusion rate constants in tetracene. In tetracene, L/sub D/ appears to be strongly temperature dependent, while L/sub P/ is not. This is explained in terms of the high density of transient singlet exciton quenchers in the α-particle track. The density of these transient quenchers is estimated to be in the range of 3 x 10^{17}—5 x 10^{18} cm^{-3}, and they are identified, in accord with a previous suggestion by Schott, as triplet excitons which are created by random recombination of electrons and holes in the α-particle track. (auth)

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 8139

9084 Some new microchemical techniques used in the preparation and study of transplutonium elements and compounds. Stevenson, J.N.; Peterson, J.R. (Univ. of Tennessee, Knoxville). *Microchem. J.*; **20**: 213-220(1975).

Six new systems were developed to prepare and study transplutonium elements and compounds. Detailed descriptions of the systems were given along with pictures or diagrams. The newly developed trifluoride reduction crucible permitted preparation of the transplutonium metal in higher than usual yield. Three annealing systems were designed to study thermal properties. A pressure vacuum reaction chamber was constructed to prepare compounds, and an x-ray powder diffraction camera was modified for use in high temperature analysis.

9085 (BNWL-tr—162) **Nondestructive method for the determination of the O/Me ratio in plutonium bearing oxide fuel.** Vollath, D. (Kernforschungszentrum Karlsruhe (F.R. Germany)). 2 Dec 1975. Translation by B. Russell of KFK—2097. 20p. Dep. NTIS $3.50.

A new nondestruction method for the measurement of the oxygen-to-metal ratio in mixed oxide fuel is reported. It is based on the measurement of the oxygen potential of the samples electrochemically and the determination of the ratio from a calibration curve. With a probability of 99.5 percent the error of the method is less than ΔO/Me = 0.005. The method can be automated. (JSR)

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 8344

9086 (SAND—75-5875) **Depth profiling of hydrogen and helium isotopes in solids by nuclear reaction analysis.** Boettiger, J.; Picraux, S.T.; Rud, N. (Aarhus Univ. (Denmark). Fysisk Inst.). 1975. 9p. (CONF-750949—2). Dep. NTIS $4.00.

From International conference on ion beam surface layer analysis; Karlsruhe, F.R. Germany (15 Sep 1975).

Recent developments in the depth profiling of hydrogen and helium isotopes in solids by use of nuclear reactions are reviewed. General considerations for depth profiling by the resonance method and by the energy-analysis method are summarized. The different nuclear reactions used for profiling of H, D, T, He and ^{4}He are intercompared with respect to depth resolution and sensitivity, and some of the limitations of the technique are discussed. (auth)

9087 (AEC-tr—7315, pp 123-130) **Neutron-resonance analysis of noble metals by the moderation time of neutrons.** Gambaryan, R.G.; Shpanov, A.P.; Shtan, A.S. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

In a study of the possibility of capture neutron resonance analysis, measurements were carried out on the assembly FIAN of the time dependence of the intensity of capture γ-rays for Au, Ag, Pd, and Pb and some samples of concentrates. Results of these investigations are given. (LK)

9088 (AEC-tr—7315, pp 217-225) **Basic technico-economical indicators of equipment with sampler for the neutron-activation analysis of materials.** Smirnova, Z.M.; Semenova, I.D.; Nikolaenko, O.K. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The technico-economical indicators of the equipment with sampler for neutron activation analysis of materials was determined. A classification of the technical parameters and economical indicators was carried out, and the interrelationships among these indicators were recognized. The technico-economical indicators were classified according to the characteristics of the developed neutron activation equipment for the quick analysis of metals for oxygen and for oxygen and nitrogen. (LK)

9089 Neutron activation analysis applied to energy and environment. Lyon, W.S. (Holifield National Lab., Oak Ridge, TN). *Trans. Am. Nucl. Soc., Suppl.*; **21**: No. 2, Suppl., 56(1975).

From Nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975).

See CONF-750928—.

CHEMICAL PROCEDURES

9090 (ISS-R—74/14) **Theoretical and experimental aspects of gel-filtration.** Araco, A.; Belli, M. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 2 Dec 1974. 57p. (In Italian). Dep. NTIS (US Sales Only) $4.50.

This report is a short review on analytic gel-filtration. The basic operating principles are first described together with the main theories on gel-filtration mechanism. Practical information is then given about the preparation and use of gel-chromatographic columns. Finally, some typical applications of gel-filtration are considered i.e., the evaluation of the molecular weights of homogeneous solutes and the analysis of the molecular weight distribution of non-homogeneous solutes. (auth)

9091 (MHSMP—75-58) **Liquid chromatographic analysis of nitration of diphenylamine stabilizer in explosives.** MacDougall, C.S. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Dec 1975. 16p. Dep. NTIS $3.50.

A high speed liquid chromatographic method was developed for the quantitative analysis of nitrated diphenylamines in PBX-9404. The procedure included extraction of the nitrated diphenylamines into methylene chloride, followed by chromatographic separation and examination of the various species. The method requires a 10-g sample of high explosive in order to provide a sample of nitro DPA suitably concentrated for chromatographic analysis. (auth)

9092 ANALYTICAL CALORIMETRY. VOLUME 3. PROCEEDINGS OF THE AMERICAN CHEMICAL SOCIETY SYMPOSIUM, LOS ANGELES, CALIFORNIA, MARCH 30—APRIL 5, 1974. Porter, R.S.; Johnson, J.G. (eds.). New York; United States of America (USA); Plenum Press (1974). 818p. (CONF-740315—). $45.00.

From 3. analytical calorimetry symposium; Los Angeles, California, USA (30 Mar 1974).

Sixty-one papers presented at the Third Symposium on Analytical Chemistry are compiled. They deal with advanced developments in the design of calorimeters and the application of analytical calorimetry to many new areas. Separate abstracts were prepared for three papers and one paper was indexed for ERDA's Energy Data Base. (JSR)

9093 Small, mini-computer-automated thermoanalytical laboratory. Catalano, E.; English, J.C. (Lawrence Livermore Lab., CA). pp 69-80 of In Analytical calorimetry. Volume 3. Porter, R.S. (ed.). New York; Plenum Press (1974).

From 3. analytical calorimetry symposium; Los Angeles, California, USA (30 Mar 1974).

See CONF-740315—.

The operational requirements imposed in the design of a mini-computer automated thermoanalytical laboratory are outlined. The computer system hardware and software and special features of the facility are described. The cost and productivity of the system are evaluated. (JSR)

9094 Determination of uranium in plutonium—238 metal and oxide by differential pulse polarography. Fawcett, N.C. (Los Alamos Scientific Lab., NM). *Anal. Chem.*; **48**: No. 1, 215-218(Jan 1976).

A differential pulse polarographic method was developed for the determination of total uranium in ^{238}Pu metal and oxides. A supporting electrolyte of 0.5 M ascorbic acid in 0.15 N H_2SO_4 was found satisfactory for the determination of 500 ppM or more of uranium in 10 mg or less of plutonium. A relative standard deviation of 0.27 to 4.3 percent was obtained in the analysis of samples ranging in uranium content from 0.65 to 2.79 percent. The limit of detection was 0.18 $\mu g\ ml^{-1}$. Peak current was a linear function of uranium concentration up to at least 100 $\mu g\ ml^{-1}$. Amounts of neptunium equal to the uranium content were tolerated. The possible interference of a number of other cations and anions were investigated. (auth)

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 8305, 8882, 9172, 9181, 9307, 9326, 9346, 9396, 9411

9095 (MLM—2286) **Nuclear safeguards progress report, July 1974—June 1975.** Ratay, R.P. (ed.). (Mound Lab., Miamisburg, Ohio (USA)). 19 Dec 1975. Contract E-33-1-GEN-53. 25p. Dep. NTIS $4.00.

A nondestructive technique for the determination of the atomic ratios of plutonium-238, -240, -241 and americium-241 relative to plutonium-239 using high-resolution gamma-ray spectroscopy was developed. Results are discussed as they apply to various compositions of plutonium-239 material, some of which have been subjected to chemical analysis. Progress to date on an automated plutonium assay system is described. This system utilizes calorimetry and high-resolution gamma-ray spectroscopy. It also features a computer controlled X, Y, Z sample-handling system as well as automated data acquisition and reduction. (auth)

9096 Contamination problems and the measurement of low-level polonium-210. Langford, J.C.; Brodzinski, R.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). *Radiochim. Acta;* **21**: No. 1, 117-118(1974).

6 refs.; 2 tabs.

A procedure is described for the measurement of low-level ^{210}Po in which the detection limit is approximately 3×10^{-3} dpm. Reagents and apparatus have been investigated for ^{210}Po contamination, and the absolute contributions from these are reported. (DE)

9097 (SAND—75-5604) **Some practical aspects of depth profiling gases in metals by proton backscattering: application to helium and hydrogen isotopes.** Blewer, R.S. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 15p. (CONF-750949—10). Dep. NTIS $3.50.

From International conference on ion beam surface layer analysis; Karlsruhe, F.R. Germany (15 Sep 1975).

Maximum detection sensitivity for hydrogen isotopes and helium is achieved by employing thin foil samples backed by a "beam trap" to prevent any portion of the incident beam which is not backscattered in the foil sample from reaching the detector. Measurements have been made to determine the magnitude and origin of "tail" or "background" counts which appear in parts of the spectra which ideally should contain no counts and which, by their presence, reduce the detection sensitivity that should theoretically be achievable for light elements. For copper foil targets, the ratio of the counts per channel of the Cu peak to the counts per channel for the background is approximately 5×10^3. The energy distribution of the background has been measured and leads one to the conclusion that for the apparatus used, these counts arise principally from decollimated incident beam protons which strike the sample holder instead of the foil sample. The enhancement in elastic scattering cross section for protons incident on ^4He is discussed and the enhancement factor for a number of other low Z elements is tabulated both for $E_o = 2.5$ MeV and for energies at which sharp resonances exist. Example spectra will be drawn from fusion reactor first wall studies presently being conducted which illustrate the effect of applying the principles discussed.

9098 (AEC-tr—7315, pp 130-140) **X-ray radiometric analysis of powdered samples of copper ores for copper and iron.** Mamikonyan, S.V.; Kozlov, O.V.; Filatov, V.I. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The results of application of the proportional counter SI-6R with the sources Ti-Zr, ^{241}Am, ^{109}Cd, and ^{170}Tm in the x-ray radiometric analysis for copper and iron are discussed. (LK)

9099 (AEC-tr—7315, pp 140-144) **Use of some radioisotope sources for the x-ray radiometric analysis of iron ores.** Kozlov, O.V.; Mamikonyan, S.V.; Przhiyalgovsku, S.M.; Filatov, V.I.; Yakubovich, A.L. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The results of the experimental testing of the sources ^3H-Zr, ^{109}Cd, /sup 119m/Sn, and ^{241}Am in the analysis of powdered samples of iron ores are given. (LK)

9100 (AEC-tr—7533/6) **Nukleonika.** Translation of *Nukleonika;* **19**: No. 6, 505-606(1974). 96p. (TT—74-54003/6). Dep. NTIS $6.00.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 8221, 9308, 9330, 10029, 10032

9101 (CONF-760401—2) **Sensitive fluorescent monitoring of carbohydrates in column chromatography.** Katz, S.; Pitt, W.W. Jr.; Mrochek, J.E.; Dinsmore, S. (Oak Ridge National Lab., Tenn. (USA)). 1976. 17p. Dep. NTIS $3.50.

From ACS national meeting on thermochemical generation of H2; New York, New York, United States of America "USA" (4 Apr 1976).

A simple, sensitive redox—fluorimetric detector for carbohydrates in column eluates is described. Optimization of the detector for monitoring carbohydrates eluted from anion exchange

columns using borate solutions as the mobile phase is discussed. New and improved techniques of using the analytical system to determine neutral carbohydrates in blood serum, urine, and various waters, and bound neutral carbohydrates in serum glycoproteins are described. (JGB)

9102 (UCRL—76742) **Laser Raman spectroscopic investigations of human and sheep erythrocyte ghosts.** Milanovich, F.P.; Shore, B.W.; Harney, R.C.; Tu, A.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Aug 1975. Contract W-7405-Eng-48. 23p. (CONF-750859—3). Dep. NTIS $3.50.

From Fall meeting of the American Chemical Society; Chicago, Illinois, USA (24 Aug 1975).

Laser Raman spectroscopy was performed on hemoglobin-free membranes from red blood cells of humans and high-$[K^+]$ and low-$[K^+]$ sheep. A spectrometer equipped with high stray-light-rejecting holographic gratings permitted spectra to be obtained within 125 cm^{-1} of the exciting line (4880 A). Signal-to-noise was sufficient to identify the postulated amide IV, V and VI and the disulphide vibrations as well as the amide I (1600 to 1700 cm^{-1}) and III (1200 to 1300 cm^{-1}). A unique capability of the Raman spectrometer, that of unlimited integration time, was applied to the amide III region. The excellent signal-to-noise ratio obtained yielded high-confidence assignments of protein secondary structure. The spectra were obtained in H_2O and D_2O. Detailed analysis of the spectra, which yielded information on the secondary structure of proteins, lipids, and lipid-protein interactions, will be presented. (auth)

9103 **Quantitative method for the determination of montmorillonite in soils.** Levy, R.; Francis, C.W. (Agricultural Research Organization, Bet Dagan, Israel). *Clays Clay Miner.*; **23**: 85-89(1975).

A quantitative method for determination of montmorillonite in the soil clay fraction, using X-ray spectrometry, is proposed. The method is based on the fact that polyvinylpyrrolidone (PVP) is adsorbed on the interlayer surfaces of montmorillonite, giving a first order c-axis spacing of 26 A, while it is not adsorbed on other swelling clays. The experimental conditions to obtain a maximum height of the X-ray diffraction peak and the effect of the mass adsorption coefficient of vermiculite on the intensity of montmorillonite were investigated. Soil montmorillonite was determined by the method of known additions, measuring the intensity of the X-ray diffraction peak before and after the addition of small and known amounts of Wyoming montmorillonite. (auth)

9104 **Introduction to local microanalysis methods: comparison between ion microprobe analysis and electron microprobe analysis.** Castaing, R. (Paris-11 Univ., 91 - Orsay (France)). pp 137-141 of In Physico chemistry and crystallography of apatites of biological interest. Paris, France; Centre National de la Recherche Scientifique (1975). (In French)

From International colloquium on physico-chemistry and cristallography of apatite of biological interest; Paris, France (10 Sep 1973).

The principles of electron probe microanalysis and secondary ion microanalysis are briefly outlined. The possibilities and limitations of these two techniques are compared and their complementary character is pointed out. (FR)

9105 **Analytical utility of the M series x-ray emission lines applied to uranium, neptunium, plutonium, and americium.** Miller, A.G. (Atlantic Richfield Hanford Co., Richland, WA). *Anal. Chem.*; **48**: No. 1, 176-178(Jan 1976).

Secondary emission x-ray analysis for actinide elements has usually meant utilizing the L series x-ray lines. The major disadvantage of these x-ray lines is that they fall in the region of high level Bremsstrahlung radiation, producing a high background and, subsequently, larger error and high detection limits. The utilization of the M series x-ray lines of actinide elements with wavelength dispersive x-ray spectrometers greatly minimizes these problems. Calibration curves for uranium, neptunium, plutonium, and americium were prepared by the "coprex" method, and the analytical characteristics of the L and M series compared. The Mα and β x-ray lines, under optimum conditions, are several times more sensitive than their L series counterparts. With the greater sensitivity in addition to the lower background, peak to background ratios for M lines up to 40 times greater than those for L lines were obtained. Detection limits can be lowered from about 0.7 μg using the Lα_1 line to 0.05 μg when M x-ray lines are used. The relative advantages and disadvantages of utilizing the L and M series x-ray lines for secondary emission x-ray analysis are discussed. (auth)

SEPARATION PROCEDURES

9106 (ANL-Trans—1001) **Influence of geometry relations of the support materials on the capacity of an extraction chromatography system. I. Variation of total capacity and the distribution coefficient of Eu^{3+} in the system HDEHP—Sio_2—HCl as a function of the pore size of the support materials (matrices).** Nolte, R.F.; Specht, S.; Born, H.J. Translated from *J. Chromatogr.*; **110**: 239-251(1975). 15p. Dep. NTIS $4.50.

9107 **Solvent extraction of cadmium from alkaline cyanide solutions with quaternary amines.** Moore, F.L. (Oak Ridge National Lab., TN). *Environ. Lett.*; **10**: No. 1, 37-46(1975).

Quaternary amines are unique in their ability to extract metal cyanides from highly alkaline solutions. Cadmium cyanide extracts essentially quantitatively at both the subnanogram and macro levels. Regeneration of the amine solvent is achieved by stripping the cadmium with sodium hydroxide, sodium hypochlorite, or alkaline or acidic formaldehyde solutions. Because they readily extract free cyanide as well as anionic metal cyano complexes, the high-molecular-weight quaternary amines show considerable promise for industrial pollution abatement applications. (auth)

9108 **Flooding rates and holdup in packed liquid—liquid extraction columns.** Watson, J.S.; McNeese, L.E.; Day, J.; Carroad, P.A. (Oak Ridge National Lab., TN). *AIChE (Am. Inst. Chem. Eng.) J.*; **21**: No. 6, 1080-1086(Nov 1975).

Countercurrent flow of liquids in columns packed with Raschig rings was studied with fluids having a wide range of physical properties. These results, along with data reported previously from other studies, were used to develop a correlation for predicting flooding rates in packed columns that is significantly better than previous correlations. Dispersed phase holdup in packed columns can be estimated over a wide range of flow rates or flow ratio by assuming a constant slip velocity between the two phases which is dependent on the properties of the fluids and packing used. Although the slip velocity is thus essentially constant at flow rates below flooding, the flooding rate correlation indicates that this term is not necessarily constant at flooding conditions. (auth)

INORGANIC AND PHYSICAL CHEMISTRY

REFER ALSO TO CITATION(S) 9251, 9259

9109 (LBL—3989) **Studies of the events occurring at gas-evolving electrodes.** Putt, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 75p. Dep. NTIS $4.50.

Thesis.

Physical events associated with the evolution of hydrogen and oxygen at electrode surfaces in concentrated sulfuric acid and potassium hydroxide solutions were observed and recorded by flash photography. A technique for photographing the electrode surface shortly after current initiation (13-300 ms) provided a view unobstructed by rising gas bubbles. Bubble growth rate, number density, and maximum bubble size data were obtained for gas generation rates in the range 3.5 - 14 cm^3/cm^2 min, corresponding to current densities for hydrogen evolution of 0.5 to 2 A/cm. The velocity of the rising gas emulsion and degree of gas bubble coalescence within it were also observed. The growth characteristics of bubbles depend strongly on the electrolyte composition, different for hydrogen and oxygen in the same electrolyte. In the range studied, increasing the gas generation rate does not change the character of the events, only the rate of their occurrence. Bubble growth before separation involves repeated sequences of coalescences. Comparison of estimates of the sizes that bubbles should reach under equilibrium growth conditions with those observed reveals that separation is controlled by the dynamics of bubble interactions. Altering the surface condition of the electrode showed that the microscopic roughness of a planar electrode has little effect on the character of gas evolution. The electrolyte velocitygenerated by the rising gas bubble stream is primarily a function of gas generation rate and is not overly dependent on the character of gas evolution. An extreme sweeping action, or "scavenging effect", of gas bubbles rising along the electrode surface occurs extensively in sulfuric acid electrolyte. (auth)

9110 **Generalized van der Waals equation of state.** Hoover, W.G. (Univ. of California, Davis); Stell, G.; Goldmark, E.; Degani, G.D. *J. Chem. Phys.*; **63**: No. 12, 5434-5438(15 Dec 1975).

The quantitative thermodynamic effect of adding a weak, long-range attraction to inverse-power repulsive potentials is studied. The resulting phase diagrams exhibit two fluid phases and a solid phase, a critical point, a triple point, and, for sufficiently soft repulsions, an additional solid phase with an additional triple point. The effects of attractions other than van der Waals' are studied too by using a simple analytic model for the canonical partition function. Although such models exhibit a wide variety of ther-

modynamic behavior, they are still not general enough to reproduce the results of high-temperature measurements on liquid metals. (auth)

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 8537, 8619, 8742, 8977, 9024, 9051, 9063, 9067, 9068, 9069, 9182, 9250

9111 (DESY-SR—75/03) **Excitons and continuum transitions of rubidium halides in the 10 to 26 eV photon energy range at low temperatures.** Zierau, W.; Skibowski, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Apr 1975. 16p. INIS.

8 figs.; 2 tabs.; 20 refs.

9112 (FRNC-TH—551) **Measurement of luminescence quantum yields and investigation of the mechanisms of energy transfer between Ce^{3+} and Tb^{3+} in Lasub(1-x-y) Cesub(x) Tbsub(y) PO_4 compounds.** Bourcet, J.C. (Lyon-1 Univ., 69 (France)). 1974. 279p. (In French). INIS.

A study was devoted to the quantum luminescence yields of the ions Ce^{3+} and Tb^{3+} in $Ce(x)Tb(y)PO_4$ compounds and the energy transfer between these two ions. This work required the development of experimental techniques to measure quantum luminescence yields under short-wave (860 to 2900 A) ultraviolet excitation. The quantum yield study revealed several strong excitation bands for terbium in the 1600-3300 A spectral range, and weaker bands between 3300 and 3900 A, whereas cerium is excited mainly between 2200 and 3000 A. Divergences between the experimental results obtained showed that the calculation must account for simultaneous absorption of the donor and acceptor. The mechanisms involved in energy transfer between the two ions were studied. A direct interaction between the Ce^{3+} and Tb^{3+} ions cannot be the predominant mechanism and the existence of another process was contemplated, i.e., the diffusion of energy between donor ions followed by a direct transfer towards terbium. From quantum measurements carried out on mixed compounds it emerges that the compounds $Ce(0.95)Tb(0.05)PO_4$ or $La(0.35)Ce(0.60)Tb(0.05)PO_4$ have a high quantum yield between 1500 and 3000 A and can therefore be of practical interest in the development of ultraviolet-visible energy converters. (FR)

9113 (LBL—4147) **Photochemistry of NO_3 and the kinetics of the N_2O_5—O_3 system.** Graham, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 236p. Dep. NTIS $8.00.

Thesis.

Kinetics of the N_2O_5—O_3 system were studied by monitoring the reactants with uv, visible, and ir spectroscopic techniques. Rate constants are reported. Photochemistry of the NO_3 radical was studied. Visible and uv absorption cross sections for NO_2, NO_3, HNO_2, and HNO_3 were also determined. (JGB)

9114 (SAND—75-5848) **Characteristics of chrysocolla pertinent to acid leaching.** Pohlman, S.L.; Olson, F.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 26p. (CONF-760203—2). Dep. NTIS $4.00.

From AIME annual meeting; Las Vegas, Nevada, United States of America "USA" (22 Feb 1976).

Physical characteristics of possible importance in the acid leaching of Chrysocolla have been evaluated. Surface area studies and pore size distribution indicate: (1) a large surface area (350 m^2/g); (2) an average pore size of 13 or 16 A, depending upon use of the adsorption, or desorption, branch of the Type IV isotherm in the evaluation; (3) the presence of a significant fraction of pores of size less than 15 A determined by the accumulation surface area method. The initial structure is microcrystalline on the basis of x-ray powder patterns; the silica leach residue is amorphous and has only 24 m^2/g surface area, and loses integrity when dry. However, readsorption of copper onto the wet leach residue gives a product with integrity and 100 m^2/g surface area. Visual observation of the leach residues supports evidence of a nonprotective diffusion mechanism of leaching which is well correlated by the shrinking core model previously presented. 40 references (auth)

9115 (ORNL-tr—4084) **Constants of formation of complex iodides of palladium(II).** Shchukarev, S.A.; Lobaneva, O.A.; Kononova, M.A. Translated by M. Gerrard from *Vestn. Leningr. Univ., Fiz., Khim.*; **20**: No. 4, 149-150(1965). 2p. Dep. NTIS $3.50.

The complex iodides of palladium (II) were investigated in aqueous solution. The values of the consecutive constants of complex stability were determined. (auth)

9116 (ORNL-tr—4050) **Kinetics of decomposition of polysilicic acid (H_2SiO_3)/sub x/ in water solution.** Stade, H.; Wieker, W. Translated by R.G. Mansfield from *Z. Anorg. Allg. Chem.*; **384**: 53-66(1971). 14p. Dep. NTIS $3.50.

The degradation of polysilicic acid was investigated in the region of pH = 1.3—5.5 and 0—65°C. At pH = 3.3 there was found a maximum (18.5 kcal/mol) and at pH = 4.3 a minimum (15.6 kcal/mol) of the activation energy of this reaction. Nucleophiles and HF accelerate the degradation. (auth)

9117 (RFP-Trans—175) **Kinetics of the interaction of lanthanum oxide with carbon dioxide.** Samuskevich, V.V. Translated from *Vestsi Akad. Navuk BSSR, Ser. Khim. Navuk*; **5**: 5-8(1972). 4p. Dep. NTIS $4.25.

Adsorption isotherms show that the reaction dies out at Δp = 1 mol CO_2, corresponding to the formation of $La_2O_2CO_3$. X-ray diagrams also show the formation of the dioxymonocarbonate, La_2O_2CO. X-ray diagrams also show the formation of only the dioxymonocarbonate. The temperature dependence of the reaction rate follows the Arrhenius equation; the activation energy is 61.3 kcal/mole. (DLC)

9118 (UCRL-Trans—10760) **Phase investigations and vapor pressure measurements on europium difluoride.** Petzel, T.; Greis, O. Translated from *Z. Anorg. Allg. Chem.*; **388**: No. 2, 137-157(1972). 27p. Dep. NTIS $3.50.

It was found that cubic europium difluoride exists over the composition range EuF 2.01 +- 0.02 to $EuF_{2.19}$+-0.02 and that the lattice parameter changes linearly from 5.842 to 5.818 A. Solid $EuF_{2.01}$+-0.02was observed to vaporize congruently from a graphite crucible at pressures of $<10^{-5}$ torr and to melt at 1,676+-5°K. The vapor pressure of solid $EuF_{2.01}$+-0.02 the temperature range 1,412-1,612°K was found by the Knudsen effusion method to be given by the equation log P/sub atm/ = - (2.036 +- 0.020)1/T x 10^4 + (8.591 +- 0.132), assuming monomeric EuF_2 to be the predominant gaseous species. Second and Third Law calculations were performed using estimated and known data for the molecular parameters of EuF_2(g) and the specific heat of EuF_2(s), and the enthalpies and entropies of vaporization at 298.15°K were obtained: $\Delta H^\circ_{298.15}$(II) = 100,84 +- 2.45 (kcal)/(Mol); $\Delta S^\circ_{298.15}$(II) = 48,92 +- 2,53 (cal)/(Grad.Mol); $\Delta H^\circ_{298.15}$(III) = 98,31 +- 2,00 (kcal)/(Mol); $\Delta S^\circ_{298.15}$(III) = 47,28 +- 2,00 (cal)/(Grad.Mol). Enthalpy of EuF_2(s) is: ΔH°/sub f,298,15/ = -284 +- 17 (kcal)/(Mol). (auth)

9119 **Enthalpy and heat of transition of Cs_2MoO_4 by drop calorimetry.** Fredrickson, D.R.; Chasanov, M.G. (Argonne National Lab., IL). pp 723-730 of In Analytical calorimetry. Volume 3. Porter, R.S. (ed.). New York; Plenum Press (1974).

From 3. analytical calorimetry symposium; Los Angeles, California, USA (30 Mar 1974).

See CONF-740315—.

Enthalpy measurements were made of Cs_2MoO_4 at temperatures from 556 to 1190°K by the drop calorimetric technique. The heat of transition of the solid phase α-β transition was measured as 1010 cal/mol. The apparatus and experimental procedure were described. (JSR)

9120 **Thermal diffusivity of olivine.** Holt, J.B. (Univ. of California, Livermore). *Earth Planet. Sci. Lett.*; **27**: 404-408(1975).

The thermal diffusivity of a naturally occurring polycrystalline olivine ($Fo_{91}Fa_{09}$) was measured by the Flash technique in the temperature range of 450 to 1500 K. At 450°K the thermal diffusivity was 10.7 X 10^{-7} m^2/sec and decreased as a function of reciprocal temperature to 7.0 X 10^{-7} m^2/sec at 800°K. From that temperature, the values gradually increased to a maximum of 7.8 X 10^{-7} m^2/sec at 1000°K, and then steadily decreased to 5.6 X 10^{-7} m^2/sec at 1500°K. The unusual decrease above 1000°K was caused by a reduction of the previously oxidized samples. The olivine's oxidation state plays a significant role in the value of thermal diffusivity at high temperatures. (auth)

9121 **Octahedral fine-structure splittings in ν_3 of SF_6.** Aldridge, J.P.; Filip, H.; Flicker, H.; Holland, R.F.; McDowell, R.S.; Nereson, N.G. (Los Alamos Scientific Lab., NM). *J. Mol. Spectrosc.*; **58**: 165-168(1975).

A report is made of high-resolution spectrum of ν_3 of SF_6 in which extensive portions of the rotational fine structure in the P and R branches are resolved for the first time. A preliminary analysis was made of this band, and rotational and octahedral splitting quantum numbers to the transitions were assigned. Similar spectra were obtained of the bending fundamental ν_4 at 615 cm^{-1}.(auth)

9122 **Polarized crystal spectra of potassium tetrachloropalladate(II) and potassium tetrabromopalladate(II).** Rush, R.M.; Martin, D.S. Jr.; LeGrand, R.G. (Ames Lab., IA). *Inorg. Chem.*; **14**: No. 10, 2543-2550(1975).

Absorption spectra have been recorded for aqueous solutions and single crystals of K_2PdCl_4 and K_2PdBr_4. For both compounds ^{1}A/sub 2g/ and ^{1}E/sub g/ peaks are not resolved in a polarization although the ^{1}A/sub 2g/ peak has the much stronger vibrational structure at 15°K. For K_2PdCl_4 the ^{1}A/sub 2g/ and ^{1}E/sub g/ states are assigned at 21,700 and 23,200 cm^{-1}, respectively, and for K_2PdBr_4 they are at 20,200 and 21,700 cm^{-1}. The ^{1}A/sub 2u/ reverse arrow ^{1}A/sub 1g/ (M reverse arrow Lπ) charge-transfer bands have surprisingly low intensity and are observed at 37,400 and 30,900 cm^{-1} for K_2PdCl_4 and K_2PdBr_4. The ^{1}B/sub 1g/ transition appears to be hidden by the ^{1}A/sub 2u/ transition in the c polarization. Weak spin-forbidden bands were observed in both polarizations for both compounds. For K_2PdBr_4 exceptional vibrational structure has been recorded at 15°K. Also, in K_2PdBr_4 two weak transitions at 37,000 and 43,200 cm^{-1} have been assigned as forbidden charge-transfer transitions. (auth)

9123 Coumarinium—europium energy transfer: efficient triplet migration between two cations. Tarassoff, P.G.; Filipescu, N. (George Washington Univ., Washington, DC). *J. Chem. Soc. (London), Chem. Commun.*; 207-209(1975).

Intermolecular triplet energy transfer from the coumarinium cation to the tripositive europic ion was demonstrated. (auth)

9124 Rate of reaction of hydrogen with liquid lithium: comparison with sodium and potassium. Parry, G.; Pulham, R.J. (Nottingham Univ., Eng.). *J. Chem. Soc. (London), Dalton Trans.*; No. 19, 1915-1917(1975).

Rates of reaction of hydrogen with a clean liquid-lithium surface were determined at 217, 244, 257, 270, and 295°C at pressures up to 23.7 kN m^{-2}. The rates range from 4.683 x 10^6 to 27.919 x 10^6 mm s^{-1} (kN m^{-2})$^{-1}$ at 217 and 295°C respectively. The reaction is first order with an activation energy of 52.8 kJ mol^{-1} which is lower than that for potassium (66.5 kJ mol^{-1}) and sodium (72.4 kJ mol^{-1}). Liquid lithium reacts more rapidly than do these metals; the rates at 250°C for Li, K, and Na are in the nearest whole number ratio of 43:4:1. The results are consistent with a report that small additions of lithium to sodium enhance the rate of hydrogen absorption. (auth)

9125 Physico chemistry and crystallography of apatites of biological interest. Elliott, J.C. (London Hospital (UK)); Mackie, P.E. (Georgia Inst. of Tech., Atlanta (USA)). pp 69-83 of In Physico chemistry and crystallography of apatites of biological interest. Paris, France; Centre National de la Recherche Scientifique (1975).

From International colloquium on physico-chemistry and crystallography of apatites of biological interest; Paris, France (10 Sep 1973).

Hydroxyapatite prepared by heating flux-grown chlorapatite in steam at 1200°C for two weeks has a monoclinic space group $P2_1/b$. The structure of such a specimen determined by x-ray diffraction methods is described. The distortions of the monoclinic hydroxyapatite structure from the very closely related hexagonal one usually found in apatites are very similar to those distortions that have been found in monoclinic chlorapatite. (FR)

9126 Lattice phonon spectra of aluminum oxide anodic films. Chatelet, J.; Claassen, H.H.; Gruen, D.M.; Sheft, I.; Wright, R.B. (Argonne National Lab., IL). *Appl. Spectrosc.*; **29**: No. 2, 185-189(1975).

Techniques have been developed for obtaining reproducible lattice phonon spectra of barrier aluminum oxide anodic films. Changes in the lattice phonon spectrum as a result of 15-keV proton bombardment are interpreted in terms of the formation of Al-OH bonds. Polarization spectra of stripped and unstripped aluminum oxide films confirm the findings of Vedder and Vermilyea, particularly with respect to the origin of the 960 cm^{-1} band. The close similarity in the observed and calculated band shapes (using the theory of Berreman) leave little doubt that the 960 cm^{-1} absorption is due to a longitudinal optic mode of the aluminum oxide lattice. (auth)

9127 (AEC-tr—7295, pp 159-164) **Present state of experimental investigation of thermophysical properties of chemically reacting systems N_2O_4, Al_2Br_6, and Al_2Cl_6.** Nesterenko, V.B.; Timofeev, B.D. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Physical and chemical properties, including ranges of dissociation, are tabulated. Work on the thermophysical properties of the three gases are reviewed. 1 table, 34 references. (DLC)

9128 (AEC-tr—7295, pp 172-175) **Effect of imperfectness on thermodynamic properties of chemically reacting mixtures.** Kessel'man, P.M.; Blank, Yu.I. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Deviations from ideality of reacting mixtures are chiefly due to the reality of the pure components. Corrections for compressibility and enthalpy are considered for steam. It is shown that even at very high temperatures, it is generally necessary to consider the real-gas effects, both thermal and calorimetric. (DLC)

9129 (AEC-tr—7295, pp 176-182) **Calculation of the "frozen" component of effective coefficient of thermal conductivity of dense, chemically reacting gases.** Kotelevskii, Yu.G.; Sviridova, V.D. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

The effective coefficient is the sum of two components: lambda /sub eff/ = lambda/sub f/ + lambda/sub r/, where lambda /sub r/ is the contribution from the chemical reaction heat, and lambda/sub f/ is the "frozen" component or the normal molecular thermal conductivity of the nonreacting mixture. Calculations were made for the systems C_2H_4—CO_2, N_2—C_2H_4, air deviations from experiment noted. Results show that general correlations for pure gases can be used to calculate the "frozen" component. (DLC)

9130 (AEC-tr—7295, pp 183-187) **Forms of gaseous oxides.** Dobrotin, R.B.; Rat'kovskii, I.A. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

This paper studies the conditions determining formation of mononuclear and multinuclear oxides in the gaseous phase. The difference between energies of single and double bonds is considered to determine the formation of multinuclear oxides, and data for this are tabulated and plotted for elements in the periodic table. (DLC)

9131 (AEC-tr—7295, pp 188-195) **Experimental study of p-v-T relationship for dissociating nitrogen tetroxide over a wide range of temperatures and pressures.** Verzhinskaya, A.B.; Khasanshin, T.S. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

For the study of the p-v-T relation for N_2O_4 at 100 to 600°C and pressures up to 300 bar, a constant-volume ballastless piezometer with "hot" valve and "hot" membrane differential manometer was used. Experimental density values are tabulated. (DLC)

9132 Optically modified mass spectra of CO_2. Ellefson, R.E. (Univ. of Wyoming, Laramie); Osterlitz, B.A.; Phillips, J.M.; Denison, A.B.; Weber, J.H. *Chem. Phys. Lett.*; **31**: No. 2, 364-368(1 Mar 1975).

The optically modified mass spectra of CO_2 were studied with respect to various experimental parameters. The proposed mechanism of ionization is photoionization from electron impact excited states of the neutral CO_2. An estimate for the cross section is 1.5 X 10^{-16} cm^2. (auth)

9133 Low-energy absorption edge in 2H-MoS_2 and 2H-$MoSe_2$. Goldberg, A.M.; Beal, A.R.; Levy, F.A.; Davis, E.A. (Cambridge Univ., Eng.). *Philos. Mag.*; **32**: No. 2, 367-378(Aug 1975).

The optical transmission of thick samples of 2H-MoS_2 and 2H-$MoSe_2$ was measured below the A exciton energy for each material. The absorption coefficients were calculated and the low absorption starting at 1.1-1.2 eV attributed to an indirect d-d

transition for both materials. There appears to be considerable d-p valence band overlap giving rise to further higher absorption before the strong A, B excitons, which have been associated with direct transitions from a p-like valence band. An energy band scheme was sketched on the basis of these interpretations. (auth)

9134 Method for recombining hydrogen and oxygen. Henrie, J.O. (to Rockwell International Corp.). US Patent 3,907,981. 23 Sep 1975. Filed date 12 Mar 1973. 6p.

A method and apparatus for thermally recombining hydrogen and oxygen is described. It is made up of a heating chamber in which the gases to be combined are initially heated to a temperature above the threshold for thermal combination or recombination, a reaction chamber into which the heated gases are transferred from said heating chamber to complete the reaction and which is formed to mix previously reacted gases with the gases delivered from said heating chamber, and temperature control means responsive to the temperature in the reaction chamber for controlling the power to the heating chamber. (auth)

9135 Measurement of the "soft" mode and coupled modes in the paraelectric and ferroelectric phases of KH_2PO_4 at high pressure. Peercy, P.S. (Sandia Labs., Albuquerque, NM). *Phys. Rev., B*; **12**: No. 7, 2725-2740(1 Oct 1975).

Measurements of the pressure and temperature dependences of the soft-mode Raman spectra of potassium dihydrogen phosphate (KDP) in both the paraelectric (PE) and ferroelectric (FE) phases are reported. The soft-mode response is overdamped throughout the PE phase at atmospheric pressure, but can be made underdamped with pressure in this phase. Measurements at high pressure in the PE phase where the response is underdamped therefore allow a more accurate determination of the parameters for the coupled-mode system than can be obtained from measurements at atmospheric pressure. Measurement of the pressure dependence in the FE phase allows identification of the soft mode of the system in this phase, and the results demonstrate that the proton motion remains coupled to an optic mode of the lattice for T<T/sub c/. The temperature and pressure dependences of the microscopic parameters are examined within the framework of both the pure tunneling and the coupled proton-optic-mode models for the phase transition. It is found that the pure tunneling model is inadequate for a detailed description of the spectra, whereas the modified tunneling model, or coupled-mode model, gives a more quantitative description of the results. While this model can be used for quantitative comparison between the Raman scattering and dielectric measurements in these materials, there are inadequacies of the model in describing the microscopic interactions. These features are discussed in detail. (auth)

9136 Analytical determination of nitride nitrogen in lithium coolants. Schlager, R.J.; Olson, D.L.; Bradley, W.L. (Colorado School of Mines, Golden). *Nucl. Technol.*; **27**: No. 3, 439-441(Nov 1975).

The corrosion behavior of stainless steels in liquid lithium is affected by the quantities of lithium nitride in lithium coolants. Monitoring the amounts of the nitride in lithium metal is important in the interpretation of liquid lithium corrosion results. Lithium nitride is determined by a titrimetric procedure that measures the ammoniaa evolved when lithium nitride dissolves in water. The ammonia is dissolved by a boric acid solution, which is then titrated with standard hydrochloric acid. (auth)

9137 Molecular photoelectron spectroscopy at 132.3 eV. The second-row hydrides. Banna, M.S.; Shirley, D.A. (Univ. of California, Berkeley). *J. Chem. Phys.*; **63**: No. 11, 4759-4766(1 Dec 1975).

Photoemission spectra of the second-row hydrides CH_4, NH_3, H_2O, and HF, as well as Ne, obtained with ultrasoft (132.3 eV) x rays from the yttrium Mzeta line and with soft x rays are compared and discussed. The 2s-derived $2a_1$ or 2σ orbitals show large relaxation energies, as do the 2s orbitals in the free atoms. The high binding energies of the $2a_1$ orbitals in CH_4 and NH_3 indicate that much of the bond energy resides in these orbitals. Bond energies estimated from changes in the average valence-electron binding energies from atoms to hydrides show rough agreement with literature values. Relative molecular orbital peak intensities show dramatic changes from 132.2 eV to 1253.6 eV photon energies, with the atomic cross-section ratio 2p/2s near unity at 132.3 eV and near 0.1 at 1253.6 eV. This difference allows peaks to be assigned to molecular orbitals in some cases by visual inspection, on the basis of atomic orbital composition. Comparison with theoretical intensities based on plane-wave or OPW continuum final states shows qualitative agreement at best, and clear disagreement in some cases. Quantitative agreement will require a more sophisticated theory. Values of $\sigma(2p)/\sigma(2s)$ for atomic C, N, O, F, and Ne were derived from the spectra at both photon energies. (auth)

9138 Non-Maxwellian H and F velocity distributions in an H_2—F_2 reaction. Riley, M.E.; Matzen, M.K. (Sandia Labs., Albuquerque, NM). *J. Chem. Phys.*; **63**: No. 11, 4787-4799(1 Dec 1975).

Time-dependent and quasi-steady-state solutions for the velocity distribution functions of H and F atoms in a burning, homogeneous, and isotropic H_2--F_2 gas mixture show an increase in the rates of the H + F_2 and F + H_2 chemical reactions that approaches a factor of two larger than the thermalized rates. The mixture is ignited by dissociating a small fraction of the F_2 molecules. Approximations to the time-dependent Boltzmann equation for the system reduce it to a form which is linear in the H and F distribution functions. This limits the solutions to early time behavior and small initial F-atom concentrations, but it allows a general picture of the burn rates to be developed from a moderate number of calculations. (auth)

9139 Electron correlation and the reality of xenon difluoride. Bagus, P.S.; Liu, B.; Liskow, D.H.; Schaefer, H.F. III. (Univ. of California, Berkeley). *J. Am. Chem. Soc.*; **97**: No. 25, 7216-7219(10 Dec 1975).

The electronic structure of xenon difluoride has been studied using ab initio theoretical methods. The primary goal was to determine whether current theoretical methods are capable of yielding a reasonable value of the dissociation energy of XeF_2. A Slater function basis set of slightly better than "double zeta plus polarization" quality was employed. Four different types of wave functions were investigated: two-configuration SCF, full valence configuration interaction (CI), the first-order wave function, and a larger 1234 configuration wave function including all double excitation from the 10σ/sub g/ orbital. Although the TCSCF symmetric stretching potential curve has both a minimum and maximum, the minimum lies above the comparable energy of separated Xe + 2F. However, the two most complete wave functions predict dissociation energies of 1.97 and 2.14 eV, in qualitative agreement with experiment, 2.78 eV. All four wave functions provide good predictions of the Xe-F equilibrium bond distance. As was the case for KrF_2, the bonding in XeF_2 is found to conform quite closely to Coulson's model F Xe^+ F^- reversible F^- Xe^+ F near the equilibrium geometry. The role of the "outer orbitals" 5d and 4f appears to be a quantitative rather than qualitative one. (auth)

9140 Study of a central force model for liquid water by molecular dynamics. Rahman, A. (Argonne National Lab., IL); Stillinger, F.H.; Lemberg, H.L. *J. Chem. Phys.*; **63**: No. 12, 5223-5230(15 Dec 1975).

The simulation technique of molecular dynamics has been used to investigate a central-force model for liquid water at 22°C and 1 g/cm^3. In this model, the same atomic pair potentials are used both for intramolecular and intermolecular interactions. Atomic pair correlation functions and velocity autocorrelation functions have been computed. The results demonstrate that stable, nonlinear, vibrating molecules are present, and that they form a random hydrogen-bond network of the type usually attributed to water. These exploratory calculations suggest that small modifications in the central potentials V/sub HH/, V/sub OH/, and V/sub OO/ would produce a more faithful representation of real water. (auth)

9141 Enhancement by helium and argon of the formation rate of the 1720-A-radiating states of Xe_2^* excited by an E beam. Rice, J.K.; Johnson, A.W. (Sandia Labs., Albuquerque, NM). *J. Chem. Phys.*; **63**: No. 12, 5235-5237(15 Dec 1975).

Helium and argon added to xenon are shown to increase markedly the formation rate of e-beam excited Xe^*_2 (1720-A radiator) without decreasing the 1720-A fluorescence efficiency. The measured association rate is interpreted in terms of three-body collisions among excited xenon atoms, ground state xenon atoms, and the added gas atoms to give rate constants of 5.0×10^{-32}, 1.4×10^{-32}, and 2.3×10^{-32} cm^6 sec^{-1} for undiluted xenon, added helium, and added argon, respectively. (auth)

9142 Oxygen—oxygen pair correlation function for computer-simulated liquid water. O'Reilly, D.E. (Argonne National Lab., IL). *J. Chem. Phys.*; **63**: No. 12, 5432-5433(15 Dec 1975).

The oxygen-oxygen pair correlation function g_{oo} for computer-simulated water is calculated for the ice Ic-VII quasilattice model of liquid water and compared with the experiments of Stillinger and Rahman (SR) both at 1 atm and at a density corresponding to a pressure of 22 kbar. The agreement between model and experiment is good and the basic differences between the SR water and real water are described. (auth)

9143 Strategies for the preparation of compounds of alkali metal anions. Dye, J.L.; Andrews, C.W.; Mathews, S.E. (Michigan State Univ., East Lansing). *J. Phys. Chem.*; **79**: No. 26, 3065-3070(18 Dec 1975).

By using alkali cation complexing agents of the crown and cryptand classes (C) and appropriate solvents, solutions can be prepared which contain essentially only M^+C and M^- in equal concentrations. From estimates of the metal solubility in the absence of the complexing agent and of the cation complexation constant, the solubility in the presence of the complexing agent can be predicted. If, in the metal solution with C absent, the e/sub solv/$^-$/M^- ratio is appreciable, then when C is used and the solution is allowed to contact excess metal, this ratio will remain nearly the same. Therefore, in addition to MC^+ and M^-, the solution may contain relatively high concentrations of e/solv/$^-$. Examples of the application of these equilibrium considerations to various metal-solvent combinations are described. Only $Na^+C.Na^-$, in which C is 2,2,2 cryptand was prepared as a crystalline solid. Gold-colored solid films were obtained by rapid evaporation of solutions of Na, K, Rb, and Cs in one or more of the solvents methylamine (MA), ethylamine (EA), and tetrahydrofuran (THF) when the complexing agent 2,2,2 cryptand is present. In addition, gold-colored films are obtained with Na and K when 18-crown-6 is used. The former metal gives the film when MA is the solvent while the latter gives it with THF. In these cases, the gold film apparently yields the metal plus 18-crown-6 when the solvent vapors are removed. The criteria for thermodynamic vs. kinetic stability of salts of M^- are considered. (auth)

9144 **Nuclear magnetic resonance studies of alkali metal anions.** Dye, J.L.; Andrews, C.W.; Ceraso, J.M. (Michigan State Univ., East Lansing). *J. Phys. Chem.*; **79**: No. 26, 3076-3079(18 Dec 1975).

The NMR chemical shift and line width were measured for $^{23}Na^-$ in tetrahydrofuran (THF), ethylamine (EA), and methylamine (MA), for $^{87}Rb^-$ in THF and EA, and for $^{133}Cs^-$ in THF. In all cases, the counterion was the 2,2,2 cryptate complex of the corresponding cation. The chemical shift of Na^- is, within experimental error, the same as that calculated for the gaseous anion (based upon the measured value for the gaseous atom) and is independent of solvent. Comparison with the solvent-dependent chemical shift of Na^+ provides conclusive evidence that Na^- is a "genuine" anion with two electrons in a 3s orbital which shield the 2p electrons from the influence of the solvent. (auth)

ISOTOPE EFFECTS

9145 **Potential constants of $K_2Zn(CN)_4$ in the crystal lattice.** Jones, L.H.; Swanson, B.I. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.*; **63**: No. 12, 5401-5410(15 Dec 1975).

The vibrational spectra of the crystalline materials $K_2Zn(CN)_4$, $K_2Zn(^{13}CN)_4$, $K_2Zn(C\ ^{15}N)_4$, $K_2\ ^{64}Zn(CN)_4$, and $K_2\ ^{66}Zn(CN)_4$ have been observed using infrared and Raman spectroscopy. A number of the potential constants in this system have been calculated from the various isotopic frequencies. It was necessary to constrain several of the potential constants which are essentially indeterminate. An analysis of these constraints was made to show that they are justified. A comparison of the potential constants of $Zn(CN)^{-2}_4$ with isoelectronic $Ni(CO)_4$ shows that for the zinc complex there is negligible back-π bonding of the zinc d orbitals to the CN ligands. A number of interesting stretch—stretch and stretch—bend interactions are discussed. (AIP)

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 9071, 9123, 9426

9146 (CEA-CONF—3074) **Hyperfine coupling and ^{13}C relaxation in alkylaniline - Ni II complexes.** Chachaty, C.; Forchioni, A.; Ronfard-Haret, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Chimie-Physique). 1975. 43p. (In French). INIS.

From One-day meeting on NMR; Liege, Belgium (14 Feb 1975).

The electron spin distribution and the hyperfine coupling parameters of α and β carbons of the alkyl groups in alkylaniline nickel acetylacetonate complexes have been accurately determined by ^1H, ^{13}C and ^{14}N contact shift measurements. It is shown that the angular dependence of the β carbon hyperfine coupling is actually given by the equation a/sub β//sup C/ = B_1/sup C/$\cos^2$theta + B_0/sub c/ rho/sub C//sup π/ with B_1/sup C/ = 27 G and B_0/sup C/ = -0.7 G, theta being the angle between the Ci-Cα-Cβ plane and the direction perpendicular to the phenyl ring. The motional average of $\cos^2$theta is related to the rotational potential barrier V_0 of the alkyl group. The value of V_0 deduced from [$\cos^2$theta] is compared to that provided by the temperature dependence of the ^{13}C relaxation time T_1 in uncomplexed 4 alkylanilines. The ^{13}C relaxation time T(1M) in complexed alkylanilines indicates that the nitrogen to Ni II distance, of which the total spin density on the ligand is dependent, varies from 2A to 3A according to the steric hindrance of the alkyl group at the vicinity of NH_2. The relaxation times T(1M) and T(2M) provide moreover the electron relaxation time T(1e) = 2 X 10^{-10}s and a reorientation correlation time of c.a. 4 X 10^{-11}s which is also found in the case of aniline and alkylanilines complexes of $Gd(DPM)_3$ and seems therefore characteristic of the ligand motion in these complexes. (FR)

9147 (CEA-N—1814) **Infrared determination of the orientation of molecules in stearamide monolayers.** Chollet, P.A.; Messier, J.; Rosilio, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jul 1975. 34p. (In French). Dep. NTIS (US Sales Only) $4.00.

The orientation of molecules in the monomolecular stearamide monolayers has been studied by infrared linear dichroism. By comparing the transmission absorption spectra carried out at different angles of incidence with the reflection absorption spectra obtained by depositing the monolayers on a metal substrate, the orientation of the dipole transition moments for a great number of normal vibration modes of the molecules may be determined to within a few degrees accuracy. Given certain assumptions, the orientation of the molecules themselves can then be deduced. (auth)

9148 (COO—3142-5) **Vacuum uv spectra of molecular crystals. Final report, February 1, 1971—June 30, 1975.** Peterson, C.W. (Connecticut Univ., Storrs (USA)). 1975. Contract AT(11-1)-3142. 8p. Dep. NTIS $3.50.

The broad goal of this work is the characterization of the optical and electronic properties of molecular crystals and biomaterials in the vacuum uv region. Work during the tenure of this contract can be summarized in two general areas: (1) Setting up and implementing a general facility for normal incidence reflection spectroscopy in the vuv region, with accompanying computer analyses for optical constants and derived functions. Detailed results were obtained on two molecular crystals in the form of thin films of tetraphenylporphyrin and its magnesium compound MgTPP. A general program for characterizing the vuv absorption of protein and nucleic acid components was set up, and specific results were obtained for tobacco mosaic virus and its protein in polymerized and unpolymerized configurations. Data were also taken on a synthetic polypeptide, polyglutamic acid in controlled morphologies. (2) Initiating a program to determine the vuv photoemission properties of biomaterials and thereby completely delineate their electronic structure. The requisite ultrahigh vacuum system was finalized and key components designed and fabricated; preliminary data will be taken by the end of the year on the prototype molecular crystal TPP. (auth)

9149 (IS-T—699) **Separated-pair independent particle model and the generalized Brillouin theorem: ab initio calculations on the dissociation of polyatomic molecules.** Sundberg, K.R. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 295p. Dep. NTIS $9.25.

Thesis.

A method is developed to optimize the separated-pair independent particle (SPIP) wave function; it is a special case of the separated-pair theory obtained by using two-term natural expansions of the geminals. The orbitals are optimized by a theory based on the generalized Brillouin theorem and iterative configuration interaction (CI) calculations in the space of the SPIP function and its single excitations. The geminal expansion coefficients are optimized by serial 2 x 2 CI calculations. Formulas are derived for the matrix elements. An algorithm to implement the method is presented, and the work needed to evaluate the molecular integrals is discussed. (auth)

9150 (JUL-Conf—13) **International symposium on generation and amplification of asymmetry in chemical systems, Juelich, 24—26 September 1973.** Thiemann, W. (ed.). (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). Nov 1974. 540p. (CONF-7309141—).

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

Twenty-two items were abstracted separately. Six were announced in Nuclear Science Abstracts and sixteen were announced in ERDA Research Abstracts. (LF)

9151 (SAND—75-7087) **Crystallographic study of hexanitroazobenzene (HNAB).** (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1967. Contract AT(29-1)-789. 25p. Dep. NTIS $3.50.

The crystallography of hexanitroazobenzene (SC-101) was investigated. Three of the five identified polymorphic forms are readily obtained under laboratory conditions and were characterized by orthographic projection. Melting points of the five different polymorphs range from 160 to 223°C. Morphological, optical, and x-ray diffraction data are also given. (JGB)

9152 (UCRL—51965) **Chemistry of aliphatic sulfurpentafluoride derivatives.** Bissell, E.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Nov 1975. Contract W-7405-Eng-48. 20p.

This report summarizes the literature through 1974 on aliphatic sulfurpentafluoride compounds. Methods of preparation and methods of transforming one pentafluorothio compound into another are briefly discussed. The physical properties of all known derivatives are tabulated. (auth)

9153 **Low-temperature calorimetric and vapor-pressure studies on alkanediamines.** Messerly, J.F.; Finke, H.L.; Osborn, A.G.; Douslin, D.R. (Bartlesville Energy Research Center, OK). *J. Chem. Thermodyn.*; **7**: 1029-1046(1975).

Low-temperature calorimetric measurements were obtained on the condensed phases three alkanediamines, ethylenediamine, (dl)-1,2-propanediamine, and 2-methyl-1,2-propanediamine, as a basis for deriving their heat capacities, C/sub s/, entropies, S/sub s/, thermodynamic functions, -[G/sub s/(T)-H°(0)/T, [H/sub s/(T)-H°(0)]/T, and H/sub s/(T)-H°(0), and the enthalpies, entropies, and temperatures of phase transitions. Vapor-pressure measurements were carried out on the above alkanediamines and (dl)-1,2-butanediamine as a means for transforming the condensed-state thermodynamic properties to the perfect-gas state at 1 atm. Standard values at 298.15°K were calculated for the enthalpy, Gibbs energy, and equilibrium constant of formation. (auth)

9154 **Electron distribution in some 1,2-disubstituted cyclooctatetraene anion radicals and dianions.** Stevenson, G.R. (Univ. of Puerto Rico, Rio Piedras); Colon, M.; Ocasio, I.; Concepcion, J.G.; Block. A.M. *J. Phys. Chem.*; **79**: No. 16, 1685-1689(1975).

The enthalpies controlling the disproportionation equilibrium constant for the anion radicals of benzocyclooctatetraene and naphthocyclooctatetraene have been studied in hexamethylphosphoramide. Upon comparing these enthalpies with those for cyclooctatetraene, we find that the enthalpy term does not reflect a strong decrease in the electron-electron repulsion in the dianions due to the extended conjugation with the benzo and naphtho ring systems. However, some delocalization of the two extra electrons into the naphtho moiety was evidenced by the entropy term, which reflects a decrease in ion pairing. The odd electron in the anion radicals of benzo- and naphthocyclooctatetraene also resides predominantly in the eight-member ring system, and the spin distribution in these systems resembles that for the 1,2-dicarbomethoxycyclooctatetraene and cyclooctatrienyne anion radicals. The tendency of the added electrons in the fused cyclooctatetraene systems to remain in the eight-member ring system is probably due to the fact that the cyclooctatetraene moiety "needs" extra electrons to approach aromaticity and the benzene ring systems already have 4n + 2 electrons. (auth)

9155 (RFP-Trans—179) **Synthesis reactions using carbon dioxide by means of transition metal complexes.** Saegusa, T.; Tsuda, T. Translated from *Kagaku Kogyo;* **26**: No. 6, 562-568(1975). 12p. Dep. NTIS $3.50.

A review is given of recent developments in the fixation of CO_2 by transition metal complexes. The interaction between transition metal complexes and CO_2, reversible fixation reactions, and contact hydrogenation of CO_2 are the topics discussed. 36 references (JSR)

9156 **Polarity effects on wavelength dependence of the fluorescence quantum yield for indole.** Kevan, L. (Wayne State Univ., Detroit); Steen, H.B. *Chem. Phys. Lett.*; **34**: No. 1, 184-188(1 Jul 1975).

The change in fluorescence quantum yield for indole as a function of excitation wavelength between 250 and 220 nm is found to vary with the static dielectric constant of various alcohol-water mixtures at 296°K. This supports the intermediacy of a CTTS state in the photoionization process. (auth)

9157 **Free energy correlation of rate constants for electron transfer between organic systems in aqueous solutions.** Meisel, D. (Carnegie-Mellon Univ., Pittsburgh). *Chem. Phys. Lett.*; **34**: No. 2, 263-266(15 Jul 1975).

Recent experimental data concerning the rate constants for electron transfer reactions of organic systems in aqueous solutions and their equilibrium constants is examined for possible correlation. The data is correlated quite well by the Marcus theory, if a reorganization parameter, λ, of 18 kcal/mole is used. Assuming that the only contribution to λ is the free energy of rearrangement of the water molecules, an effective radius of 5 A for the reacting entities is estimated. For the zero free energy change reaction, i.e., electron exchange between a radical ion and its parent molecule, a rate constant of about 5×10^7 M^{-1} s^{-1} is predicted. (auth)

9158 **Basicity and ion-molecule reactions of trimethylarsine in the gas phase determine by ion cyclotron resonance spectroscopy.** Hodges, R.V.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *Inorg. Chem.*; **14**: No. 12, 2887-2889(Dec 1975).

The gas-phase ion—molecule reactions of trimethylarsine were investigated by ion cyclotron resonance spectroscopy. Reaction pathways, rate constants, and product distributions were determined by the variation of electron energy and by trapped-ion and double-resonance techniques. The parent ion reacts with $(CH_3)_3As$ to give $(CH_3)_5As_2^+$ and a methyl radical. The two principal fragment ions, $(CH_3)_2As^+$ and $C_2H_4As^+$, react to give the protonated parent ion and also undergo condensation reactions. The gas-phase basicity (proton affinity) of trimethylarsine was determined to be 209.3 kcal/mole [relative to PA(NH_3) = 201 kcal/mole] from investigations of proton-transfer equilibria. This result is consistent with previously established trends in the basicities of group 5 hydrides and their methyl derivatives. (auth)

9159 **Crystal and molecular structure of chlorobis (3-butenyldiphenylphosphino) rhodium(I).** Ryan, R.R.; Schaeffer, R.; Clark, P.; Hartwell, G. (Los Alamos Scientific Lab., NM). *Inorg. Chem.*; **14**: No. 12, 3039-3042(Dec 1975).

The structure of chlorobis(3-butenyldiphenylphosphino)rhodium(I) was determined by three-dimensional x-ray diffractometer techniques. The compound crystallizes in the space group $P2_1/c$ with cell constants of a = 10.697 (5) A, b = 9.832 (5) A, c , 36.44 (2) A, and β = 96.42 (3)°; Z= 4. The structure, solved by heavy-atom techniques, was refined by full-matrix least-squares methods using the 4218 reflections which had intensities 3 σ above background to an unweighted R value of 5.1 percent. The coordination around the Rh(I) atom is best described as trigonal bipyramidal with one phosphorus and the midpoints of the two olefinic groups forming the equatorial plane which lies 0.13 A toward the Cl atom from Rh(I). In spite of the different geometric constraint imposed by the butenyl chains, both olefinic groups lie in the equatorial plane (within 8.5°). This phenomenon and the placement of the best π acceptor in the equatorial plane are interpreted in terms of a synergetic cooperation between the π and σ bonding in this plane.

9160 **Pressure dependence of the molecular rotational correlation times of benzene and pyridine.** Assink, R.A. (Sandia Labs., Albuquerque, NM). *J. Chem. Phys.*; **63**: No. 11, 5045-5046(1 Dec 1975).

On the basis of previous experimental measurements on benzene, a theoretical pressure dependence is calculated for the effective rotational correlational times of benzene and pyridine. (JSR)

9161 **Charge-transfer complexes. $NH_3—F_2$, $NH_3—Cl_2$, $NH_3—ClF$, $N(CH_3)_3—F_2$, $N(CH_3)_3—Cl_2$, and $N(CH_3)_3—ClF$.** Lucchese, R.R.; Schaefer, H.F. III. (Univ. of California, Berkeley). *J. Am. Chem. Soc.*; **97**: No. 25, 7205-7210(10 Dec 1975).

Nonempirical elecronic structure theory has been applied to several charge-transfer complexes, which involve ammonia and trimethylamine as electron donors, and molecular fluorine, chlorine, and ClF as electron acceptors. The self-consistent field calculations employed both minimum and double-zeta basis sets of contracted Gaussian functions. For NH_3-F_2 and NH_3-ClF, the importance of d functions on the N, F, and Cl atoms was investigated. In several cases the minimum basis results do not appear reliable. With the geometries of the donor and acceptor molecules fixed from experiment, the equilibrium geometries of the charge-transfer complexes were predicted. N-X (X = nearest halogen atom) distances are 3.08 A (NH_3-F_2), 2.93 A (NH_3-Cl_2), and 2.65 A (NH_3-ClF), while the predicted binding energies are 0.6 kcal (NH_3-F_2), 2.4 kcal (NH_3-Cl_2), and 7.7 kcal (NH_3-ClF). NH_3-FCl is predicted to be bound by less tha 0.1 kcal/mol. The most intriguing prediction is that the binding energies of the ammonia complexes are greater than those of the corresponding trimethylamine complexes. Although this prediction is in distinct disagreement with accepted chemical intuition, it is consistent with Mulliken populations, which suggest a significantly greater "negative charge" on the ammonia N atom than that for trimethylamine. Further, the dipole moment of NH_3 is significantly larger than that of $N(CH_3)_3$. (auth)

9162 **Electronic structure of diarbonyls. The ground state of glyoxal.** Dykstra, C.E.; Schaefer, H.F. III. (Univ. of California, Berkeley). *J. Am. Chem. Soc.*; **97**: No. 25, 7210-7215(10 Dec 1975).

The ground electronic state of the simplest α-dicarbonyl, glyoxal, $(CHO)_2$, has been studied by ab initio self-consistent field (SCF) methods using a double-zeta basis set of contracted Gaussian functions. The internal rotation potential curve was determined by optimizing the five structural parameters in the cis and trans forms and three intermediate geometries. The cis-trans energy separation was found to be 5.9 kcal/mol with the trans being the lower form. The internal rotation barrier was 7.5 kcal/mol with respect to the trans minimum, and the potential maximum occurs at an angle of about 102° away from the trans planar form. The energy ordering of the highest occupied molecular orbitals was determined to be n, π, n, and π, in order of increasing Koopmans theorem ionization potential. The close correspondence of these orbitals with those of two interacting CO molecules made possible generalizations of ground electronic state structure of α-dicarbonyls and some predictions concerning excited electronic states. (auth)

9163 **Effect of temperature on conduction band energies of electrons in nonpolar liquids.** Holroyd, R.A.; Tames, S.; Kennedy, A. (Brookhaven National Lab., Upton, NY). *J. Phys. Chem.*; **79**: No. 26, 2857-2861(18 Dec 1975).

The energy of injection of an electron from vacuum into various nonpolar liquids was studied as a function of temperature. The method used was based on the difference in the photoelectric work function of zinc under vacuum and in the liquid; the difference: phi/sub liq/ — phi/sub vac/, is denoted V_0. Measurements are reported for n-pentane, n-hexane, 2,2-dimethylbutane, 2,2,4-trimethylpentane, 2,2,5-trimethylhexane, 2,2,4,4-tetramethylpentane, and tetramethylsilane (Me_4Si). In all cases V_0 increases with decreasing temperature. The increase is largest for n-hexane (0.0024 eV/°C), less for the branched hydrocarbons (~0.016 eV/°C), and smallest for Me_4Si (0.0005 eV/°C). The temperature dependence is roughly in accord with the Springett, Jortner, and Cohen model. The data on hydrocarbons show that V_0 increases as the free volume in the liquid decreases. (auth)

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 9580

ELECTROCHEMISTRY

9164 (LBL—4537) **Primary resistances for ring-disk electrodes.** Miksis, J.J. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 49p. Dep. NTIS $4.00.

Thesis.

A system consisting of a disk electrode, a concentric ring electrode, and a large counterelectrode at infinity has three independent resistance values describing the primary potential difference between any two electrodes when current is passed between any two electrodes. These resistance values are calculated and presented as dimensionless correlations as functions of the ratios of radii of the disk and ring. (auth)

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 8380, 8381, 9113, 9121, 9174

9165 (AED-CONF—75-388-001) **New oxidation and photo-oxidation products of tryptophan.** Savige, W.E. 1975. 9p. INIS.

From 5. international symposium on wool textile research; Aachen, F.R. Germany (2 Sep 1975).

1 fig.; 21 refs. With abstract.

Dye-sensitized photo-oxidation of tryptophan in water gives N'-formylkynurenine and (+-)-3a-hydroxy-1,2,3a,8,8a-hexahydropyrrolo[2,3-b] indole-2-carbosylic acid. The latter rearranges to oxindolyl-3-alanine on irradiation with uv light and reacts with thiols, including cysteine, in warm 20 percent acetic acid to give the corresponding 2-tryptophyl sulphides. (DE)

9166 **Laser induced chemiluminescence of BCl_3/H_2S mixtures.** Rockwood, S.D. (Los Alamos Scientific Lab., NM). *Chem. Phys. (Amsterdam)*; **10**: 453-457(1974).

Visible chemiluminescence was observed from mixtures of BCl_3 and H_2S when subjected to intense 10.6 μm radiation from a CO_2 laser. The spectrum of the emission was found to contain a molecular band structure superimposed on an underlying continuum. The visible fluorescence displays a strong dependence on the incident CO_2 laser power and a temporal component that is faster than gas collision times. The implications of this with regard to laser isotope separation are discussed. (auth)

9167 **Mercury-photosensitized production of free radicals in organic glasses.** Bremer, N.; Brown, B.J.; Morine, G.H.; Willard, J.E. (Univ. of Wisconsin, Madison). *J. Phys. Chem.*; **79**: No. 20, 2187-2192(1975).

Trapped free radicals are produced by Hg-photosensitized reactions when 3-methylpentane (3MP), CH_3OH, C_2H_5OH or C_3H_7OH glasses containing dissolved or vapor deposited Hg are exposed to 254- or 185-nm light at 77°K. During illumination at 254 nm the uv absorption peak of the Hg in the region of 250 to 260 nm decreases while the radical concentration grows to a plateau. Subsequent steady illumination with broad band uv light regenerates part of the original Hg absorbance and is accompanied by continuing growth in radical concentration with a yield of many radicals per dissolved Hg atom. A search for ESR and optical absorption lines of HgH in samples from which the Hg absorbance has been bleached has yielded negative results. The optical absorption spectrum of the radicals produced in 3MP is reported. (auth)

9168 **Laser driven synthesis of $BHCl_2$ from BCl_3 and H_2.** Rockwood, S.D.; Hudson, J.W. (Los Alamos Scientific Lab., NM). *Chem. Phys. Lett.*; **34**: No. 3, 542-545(1 Aug 1975).

Mixtures of BCl_3 and H_2 were irradiated by a pulsed CO_2 laser yielding $BHCl_2$ and HCl as the only products. Approximately 50 percent conversion of the reagents was obtained with a quantum efficiency of 122 10.6 μ photons per $BHCl_2$ molecule. The product yield was observed to scale with laser power as (P/P_0)/sup 1.26/. (auth)

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 9083, 9514

9169 (RRL—3238-541(Q-73)) **Mellon Institute of Science, Radiation Research Laboratories quarterly report, 1 July 1975—30 September 1975.** (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). 8 Oct 1975. 19p. Dep. NTIS $3.50.

Abstracts are given of reports issued during the quarter. Other current research programs are briefly summarized. (JSR)

9170 (RRL—3238-542) **Annual report, October 1, 1974—September 30, 1975.** (Mellon Inst. of Science, Pittsburgh (USA). Radiation Research Labs.). 10 Oct 1975. Contract AT(11-1)-3238. 31p. Dep. NTIS $4.00.

Research progress is reported in the following areas: steady-state radiolysis—ESR studies, optical pulse radiolysis studies, time-resolved ESR spectroscopy, and liquid chromatographic examination of radiation-produced products. Brief summaries of other studies, as well as a list of publications and oral presentations, are also included. (JGB)

9171 (SRO—640-7) **Radiolysis of water in a wide range radiolysis source. Progress report, September 1, 1967—August 31, 1974.** Melton, C.E. (Georgia Univ., Athens (USA). Dept. of Chemistry). 27 Jan 1976. Contract AT(38-1)-640. 10p. Dep. NTIS $3.50.

A brief summary of the progress on the study of the radiolysis of water is given. The twelve publications resulting from this work are listed. (LK)

9172 (AEC-tr—7533/10) **Nukleonika.** Translation of *Nukleonika*; **19**: No. 10, 851-948(1974). 86p. (TT—74-54003/10). Dep. NTIS $5.00.

9173 (AEC-tr—7295, pp 216-223) **Coefficient of heat transfer in a slit-shaped chemonuclear channel.** Kazazyan, V.T.; Roginets, L.P. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Factors to be considered in solving problems of heat transfer in the radiation element of a chemonuclear reactor include: variable thermophysical properties because of the change in composition of the reagent during nonisothermal flow in the radiation field along the height of the channel, radiation-chemical reactions, and energy liberation along the cross-section of the channel in the reagent, as well as the channel walls. (MCG)

9174 Reactions of solvated electrons with solutes at high concentrations. A laser photolysis and pulse radiolysis study. Bromberg, A.; Thomas, J.K. (Univ. of Notre Dame, IN). *J. Chem. Phys.*; **63**: No. 5, 2124-2130(1 Sep 1975).

Solvated electrons were produced in several liquids by laser photoionization of aromatic solutes, and by pulse radiolysis. The yields of solvated electrons were decreased by high concentrations (0.1 - 1.0M) of phenol, benzene, and ethyl acetate; the effectiveness of the solutes in reducing the e⁻/sub s/ yields was greater in the photolysis experiments than in the corresponding pulse radiolysis experiments. The data were, however, identical with light of wavelength 3471 or 2650 A, from ruby and neodymium lasers, respectively. The data are used to discuss several theories. Solvated electrons in alcohols were photobleached with red light (lambda = 6942 A) giving H atoms. The quantum yield for the process was found to be low. (auth)

9175 Mode of reaction of O^- radical with aromatic systems. Neta, P.; Schuler, R.H. (Carnegie-Mellon Univ., Pittsburgh). *Radiat. Res.*; **64**: No. 2, 233-236(Nov 1975).

The rate constants for reaction of O^- with a number of substituted benzenes and toluenes have been measured. While the values for abstraction from the methyl group of the toluenes (k approximately 10^9 M^{-1} sec^{-1}) are considerably greater than for addition to the ring (k less than 10^8 M^{-1} sec^{-1}) they are not strongly influenced by additional substitution. The dependence of rate constants on the substituents indicates that O^- is less electrophilic than is OH. The reaction of O^- with phenols and anilines is also quite rapid (k approximately 10^9 M^{-1} sec^{-1}), indicating that in these cases reaction takes place via electron transfer and not addition. (auth)

9176 The oxidation and reduction of succinic acid by ionizing radiation. Budzinski, E.E.; Box, H.C. (Biophysics Department, Roswell Park Memorial Institute, Buffalo, New York 14263). *J. Chem. Phys.*; **63**: No. 11, 4927-4929(1 Dec 1975).

The oxidation of succinic acid was observed by ESR—ENDOR spectroscopy in single crystals x irradiated at 4.2 degreeK. Oxidation products result from loss of hydrogen from the saturated carbon atoms as well as from the carboxyl groups. Reduction is a more specific process; electrons are captured by carbonyl oxygen atoms. The competition for electrons between succinic acid and fumaric acid in doped crystals was examined at 4.2 degreeK. (AIP)

9177 Picosecond pulse radiolysis. I. Time or concentration dependent rate constants. Jonah, C.D.; Miller, J.R.; Hart, E.J.; Matheson, M.S. (Argonne National Lab., IL). *J. Phys. Chem.*; **79**: No. 25, 2705-2711(4 Dec 1975).

Rate constants for the reaction of the hydrated electron withreactive solutes at high concentrations have been measured, using our single fine-structure pulse stroboscopic apparatus. The accessible time region is 50 to 3500 psec. A time-dependent rate constant in accord with theory was found for the neutral reactant, nitromethane, whereas acetone reacting one-third as fast showed no time dependence. For e⁻/sub aq/ + NO_3^- the rate constant increases with concentration (i.e., at short times), owing both to the ionic strength effect and the time dependence effect. Only time-dependent effects seem to be present in our concentration range for the reactions of the hydrated electron with IO_4^- and CrO_4^{2-}. Ionic strength effects seem to be absent, probably because tunneling extends the reaction radii to about 10 A where coulomb forces between the reactants are small. Cd^{2+} reacts with e⁻/sub aq/ at nearly the diffusion-limited rate so that no Cd^{2+} ion atmosphere can form about surviving e⁻/sub aq/. Thus, reacting Cd^{2+} has an anion atmosphere but e⁻/sub aq/ reacts without a cation sheath in pure $Cd(ClO_4)_2$ solution, and this decreases the effect of ionic strength on the rate constant. The effect is estimated from experimental data. Cu^{2+} reacts at half the diffusion-limited rate so a partial Cu^{2+} atmosphere can build up about e⁻/sub aq/. (auth)

9178 X-ray photoemission spectroscopy study of hexavalent uranium compounds. Veal, B.W.; Lam, D.J.; Carnall, W.T.; Hoekstra, H.R. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B*; **12**: No. 12, 5651-5663(15 Dec 1975).

The electronic structure of the outer occupied levels of a series of hexavalent uranium (predominately uranyl) compounds was studied using x-ray photoemission spectroscopy (XPS). The changes in the spectral features of the outer occupied levels with the variation of the uranium-oxygen bond lengths (1.7—2.1 A) are systematically investigated. Previously unexplained spectral structure has been found to result from ligand-field splitting of the occupied U $^6p_{3/2}$ levels. The XPS results are compared with predictions of a relativistic molecular-cluster calculation and with the results of a simple point-charge crystal-field model. When the crystalline electric fields generated by both the primary and secondary ligands are taken into consideration, excellent quantitative agreement is obtained between the XPS data and the molecular-cluster results with no parameter adjustment. (AIP)

9179 Electron attachment of sulfur hexafluoride in nonpolar liquids. Bakale, G. (Case Western Univ., Cleveland); Sowada, U.; Schmidt, W.F. *J. Phys. Chem.*; **79**: No. 26, 3041-3044(18 Dec 1975).

The rates of electron attachment to SF_6 were measured in liquid methane, ethane, and propane as a function of the temperature. The data are discussed with relation to the models proposed for the electron motion in these liquids. (auth)

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

REFER ALSO TO CITATION(S) 9716

9180 (CONF-750515—, pp 133-140) **Methods for training radiochemical technicians at ORNL.** Parrott, J.R.; Nicol, R.G. (Oak Ridge National Lab., TN). May 1975.

From 2. ANS symposium on training of nuclear facility personnel; Gatlinburg, Tennessee, USA (11 May 1975).

In Proceedings of the second symposium training of nuclear facility personnel.

The training of personnel to carry out radiochemical operations at ORNL is a formidable and recurrent task since repetitive, production-type operations are not involved, and programs are constantly shifting. It is essential that provisions be made for the routine retraining of personnel if they are to make effective contributions on a continuing basis. The present training methods have emerged as a result of thirty years experience in a variety of radiochemical pilot-plant programs. These programs have included operations performed in glove boxes, hot-cell manipulator work handling high-neutron-emitting isotopes, and the entire spectrum of remote solvent extraction operations. Present methods of training and the results obtained are summarized. (auth)

HOT-ATOM CHEMISTRY

9181 (COO—1617-45) **Halogen atom reactions activated by nuclear transformations. Progress report, February 15, 1975—February 14, 1976.** Rack, E.P. (Nebraska Univ., Lincoln (USA). Dept. of Chemistry). Feb 1976. Contract E(11-1)-1617. 46p. Dep. NTIS $4.00.

High energy reactions of halogen atoms or ions, activated by nuclear transformations, are being studied in gaseous, high pressure, and condensed phase saturated and unsaturated hydrocarbons, halomethanes, and other organic systems. Experimental and theoretical data are presented in the following areas: systematics of iodine hot atom reactions in halomethanes, reactions and systematics of iodine reactions with pentene and butene isomers, radiative neutron capture activated reactions of iodine with acetylene, gas to liquid to solid transition in hot atom chemistry, kinetic theory applications of hot atom reactions and the mathematical development of caging reactions, solvent dependence of the stereochemistry of the ^{38}Cl for Cl substitution following $^{37}Cl(n,\gamma)$ ^{38}Cl in liquid meso and dl-$(CHFCl)_2$. A technique was also developed for the radioassay of Al in urine specimens. (JSR)

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 9084, 9471

9182 (MLM—2234) **Dissolution methods.** Silver, G.L. (Mound Lab., Miamisburg, Ohio (USA)). 6 Jan 1976. Contract E-33-1-GEN-53. 23p. Dep. NTIS $4.00.

This review of dissolution procedures contains one hundred suggestions and references about the dissolution of various substances. Work and dissolution are illustrated with a work diagram for plutonium. (auth)

9183 (ORNL—5050) **Chemical Technology Division annual progress report for period ending March 31, 1975.** (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 123p. Dep. NTIS $5.45.

9184 (UCRL—77709) **Preparation of californium diiodide.** Wild, J.F.; Hulet, E.K.; Lougheed, R.W.; Hayes, W.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. 10p. (CONF-750112—4). Dep. NTIS $3.50.

From Symposium commemorating the 25th anniversary of the discovery of elements 97 and 98; Berkeley, USA (20 Jan 1975).

The preparation and identification of the hexagonal and rhombohedral forms of CfI_2 are reported. (LK)

9185 Heat capacity, entropy, enthalpy, and Gibbs energy of $^{242}PuF_4$ from 10 to 350 degreeK. Osborne, D.W.; Flotow, H.E.; Fried, S.M.; Malm, J.G. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.*; 63: No. 11, 4613-4617(1 Dec 1975).

Heat capacity measurements have been made on a 20.9 g sample of $^{242}PuF_4$ from 10 to 350 degreeK. The measurements from 20 to 350 degreeK were made by intermittent electrical heating with corrections based on the observed temperature drifts. Heat capacities determined in this way were compared with temperature drifts without electrical heating in the range 20 to 56 degreeK to evaluate the radioactive self-heating rate as (1.214+-0.004) x10^{-4} W/g Pu. From 10 to 20 degreeK heat capacities were obtained from this value of the radioactive self-heating rate and the temperature drifts without electrical heating. The heat capacity curve had the normal sigmoid shape. At 298.15 degreeK the heat capacity Cdegree/subp/, entropy S degree, enthalpy H degree-H degree$_0$, and tempered Gibbs energy (G degree-H degree$_0$)/T are, respectively (116.19+-0.29) J degreeK^{-1}x mole^{-1}, (147.25+-0.37) J degreeK^{-1}x mole^{-1}, (22 385+-56) J mole^{-1}, and -(72.17+-0.18) J degreeK^{-1}x mole^{-1}. The changes in various thermodynamic functions for the formation of PuF_6(g) from PuF_4(c) and F_2(g) are evaluated at 550 and 298.15 degreeK. (AIP)

RADIOISOTOPE PRODUCTION

9186 (AEC-tr—7315) **Radiation Technology, Issue 6.** Translation of *Radiats. Tekh.*; No. 6, (1971). 240p. (TT—72-58020). Dep. NTIS $7.60.

The publication deals with theoretical and experimental works on the nuclear-physical basis of radiation technology, isotope thermoelectric generators, equipment irradiation, pulse proton generator, nuclear methods of analysis, gamma flaw detection, radiotherapeutic and x-ray diagnostic equipment. The technical experience in the preparation of the separate units of radiation technology and the description of articles prepared in VNIIRT are given. Beta thickness gauge of films, experimental hose gamma therapeutic apparatus for in-cavity irradiation, radioisotope scintillation level-gauge-regulator, and a universal radioisotope relay apparatus are discussed. The economical effectiveness of new gamma flaw detectors, the technico-economical indicators of installations of neutron activation analysis, and a logical structural model of forecasting radiation technology are covered. Individual abstracts were included for each item. (auth)

9187 (AEC-tr—7315, pp 2-10) **Production of isotopes formed through an intermediate nucleus by neutron capture.** Terent'ev, V.P.; Zharkov, V.A.; Fradkin, I.M.; Chavychalova, T.P. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The α-emitter isotopes (^{238}Pu, ^{242}Cm, ^{244}Cm, ^{210}Po, and others) are beginning to play a leading role in the general balance of radioisotope indicators. They can be received by irradiation in the nuclear reactor according to the following scheme. The nucleus of the practically stable initial isotope captures a neutron forming an intermediate nucleus, which decays with a sufficiently small half-life period (not more than a few days) into the nucleus of the isotope of interest. The production process can be divided into individual cycles. Each cycle includes preparation of the initial product, its irradiation in the reactor, and the chemical separation of the produced isotope from the remaining starting material. In the following, the choice of the regime of irradiation for each cycle is discussed. For this purpose, the fate of the material of the first batch is traced in the case of its complete use in subsequent cycles. The condition of obtaining a maximum amount of the fuel isotope is chosen as a criterion of optimization of the process. (auth)

9188 (AEC-tr—7315, pp 11-13) **Use of neutrons for the production of radioactive isotopes.** Fradkin, G.M.; Zharkov, V.A.; Terent'ev, V.P. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The isotopic fuels considered can be divided into two groups according to their modes of formation. The first group contains ^{60}Co, ^{170}Tm, and ^{192}Ir, which do not differ in chemical properties from the initial isotopes. The second group contains ^{210}Po, ^{227}Ac, ^{232}U, ^{238}Pu, ^{242}Cm, and ^{244}Cm, which have an atomic number higher by unity than the atomic number of the initial isotopes. The irradiation requirements for each group are stated. (LK)

ENGINEERING

GENERAL ENGINEERING

REFER ALSO TO CITATION(S) 8949

9189 (SAND—75-7072) **Ribbon and gliding type parachutes evaluated in the 7 by 10 foot transonic wind tunnel.** Ottensoser, J. (Naval Ship Research and Development Center, Bethesda, Md. (USA). Aviation and Surface Effects Dept.). Sep 1975. Contract AT(29-1)-789. 194p. Dep. NTIS $7.50.

For Sandia Labs., Albuquerque, NM.

An experiment has been conducted in the NSRDC 7- x 10-foot transonic tunnel for the Sandia Corporation to evaluate various parachute parameters. The experiment consisted of three main parts: the first phase evaluated the disreefing characteristics of the various parachutes as well as the drag forces before, during, and after disreefing; the second phase measured the pressure distribution around the chute as well as the drag forces; and the final phase evaluated the disreefing and drag characteristics of gliding type parachutes. The free stream dynamic pressure varied from 65 to 500 psf. 12 figures, 1 table. (auth)

9190 (UCRL—77659) **Prediction and determination of explosive-induced fracture.** Butkovich, T.R.; Hearst, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jan 1976. Contract W-7405-Eng-48. 43p. (CONF-760120—1). Dep. NTIS $4.00.

From Conference oF Society of Explosive Engineers on explosion and blasting techniques; Louisville, Kentucky, United States of America "USA" (28 Jan 1976).

Explosive-induced fracturing and permeability enhancement far from a free face were studied. A one-dimensional computer program, SOC, was used to predict the total failure-associated distortional strain, ϵ/sub f/. Laboratory and field experiments associated the calculated ϵ/sub f/ with the observed fracture and permeability enhancement. An ϵ/sub f/ value of 0.015 corresponded to the observed radius of effect, which was about seven times the cavity radius and was consistent with predictions from SOC and from the literature.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 8188, 8338, 10055

9191 (BDX—613-1354(Rev.)) **Process acceptance and adjustment techniques for swiss automatic screw machine parts. Final report.** Robb, J.M. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1976. Contract AT(29-1)-613. 25p. Dep. NTIS $4.00.

Product tolerance requirements for small, cylindrical, piece parts produced on swiss automatic screw machines have progressed to the reliability limits of inspection equipment. The miniature size, configuration, and tolerance requirements (plus or minus 0.0001 in.) (0.00254 mm) of these parts preclude the use of screening techniques to accept product or adjust processes during setup and production runs; therefore, existing means of product acceptance and process adjustment must be refined or new techniques must be developed. The purpose of this endeavor has been to determine benefits gained through the implementation of a process acceptance technique (PAT) to swiss automatic screw machine processes. PAT is a statistical approach developed for the purpose of accepting product and centering processes for parts produced by selected, controlled processes. Through this endeavor a determination has been made of the conditions under which PAT can benefit a controlled process and some specific types of screw machine processes upon which PAT could be applied. However, it was also determined that PAT, if used indiscriminately, may become a record keeping burden when applied to more than one dimension at a given machining operation. (auth)

9192 (BNL—20684) **Formulation of stiffness equation for a three-dimensional isoparametric element with elastic-plastic material and large deformation.** Chang, T.Y.; Prachuktam, S.; Reich, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 3 Nov 1975. 17p. Dep. NTIS $4.50.

The formulation of the stiffness equation for an 8 to 21 node isoparametric element with elastic-plastic material and large deformation is presented. The formulation has been implemented in a nonlinear finite element program for the analysis of three-dimensional continuums. To demonstrate the utility of the formula-

tion, a thick-walled cylinder was analyzed and the results are compared favorably with a known solution. The element type presented can be applied not only to 3-D continuums, but also to plate or shell structures, for which degenerated isoparametric elements may be used. (auth)

9193 (JINR—P13-9221) **Five-layer ferromagnetic screen with the volume of 1.5 m³. I. Construction.** Alekseev, N.A.; Voronov, B.I.; Konstantinov, V.I.; Taran, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

A five-layer cylindrical permalloy screen is described with the internal volume of about 1.5 m³ intended for shielding from the geomagnetic field and from the low frequency noise of the "Tristom" installation used for measuring the electrical dipole moment of a neutron by ultracold neutrons. The residual magnetic field (3/3.5) x 10^{-5} Oe has been obtained in the center of the screen. The stability of the field was kept within +- 0.5 x 10^{-5} Oe during a month. The screen can be used for gauging of the magnetometric devices of different designation and for that purpose the screen has holes 150 mm in diameter at the ends. (auth)

9194 (LA-UR—75-2242) **Helical wick structures for gravity-assist heat pipes.** Deverall, J.E.; Keddy, E.S. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 10p. (CONF-760313—1). Dep. NTIS $3.50.

From 2. international conference on heat transfer; Bologna, Italy (31 Mar 1976).

A program was undertaken to develop a wick structure suitable with potassium as a working fluid in heat pipes for thermal control of irradiation capsules having a high heat transfer capability in the temperature range from 870 to 920°K. The most suitable design appeared to be a multiple-helix system which provides a low flow resistance, minimum liquid inventory, good liquid distribution, a relatively large vapor passage, and a means for reducing liquid-vapor interaction. Seven different wick structures were designed and tested and heat transfer rates up to 10 kW were attained. The results of this investigation indicate that high capacity heat pipes can be constructed to operate in the gravity-assist mode in a lower temperature range than is possible with sodium. The tests also revealed a new heat pipe limit which has not previously been considered.

9195 (LA-UR—75-2308) **Vapor flow considerations in conventional and gravity-assist heat pipes.** Kemme, J.E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 14p. (CONF-760313—2). Dep. NTIS $3.50.

From 2. international conference on heat transfer; Bologna, Italy (31 Mar 1976).

Terrestrial applications for heat pipes have grown rapidly in recent years, particularly in areas involving permafrost stabilization and energy conservation. Ordinarily, these applications do not require heat pipes that are conventional in the sense that circulation of working fluid is maintained exclusively by capillary forces. Instead, they usually permit heat-pipe operation with the condenser elevated so that condensate is returned to the evaporator with gravity assistance. When operated in this manner, relatively high rates of heat transfer have been achieved even with heat pipes containing simple and inexpensive wicks and working fluids having low surface tensions. When the performance of a heat pipe is improved substantially by gravity assistance or by employing some type of composite wick, heat transfer is often limited primarily by vapor flow effects as opposed to liquid pressure losses. Five separate effects and their associated limitations were encountered in experiments with liquid-metal working fluids. All are identified, but most attention is devoted to those that are not fully understood. Equations are provided to show how these limitations are influenced by heat-pipe geometry, wick structure, working fluid properties, and manner of operation. It should be emphasized, however, that some equations are tentative in nature and will require additional experimental verification.

9196 (MHSMP—75-39) **Comparison of Millipore Particle Measurement Computer System (πMC), wet sieve analysis and microscopy analysis (modified Zeiss analyzer) for particle characterization. Period covered: July—September 1975.** Duncan, A.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1975. 69p. Dep. NTIS $4.50.

A comparative study of powder characteristics measured by the Millipore Particle Measurement Computer System (πMC) versus wet sieve analysis and microscopy analysis was prompted by a need to replace the latter methods with a more automated system. With the present procedures followed in instrument operation and computation of the data, the results indicate the following problem areas with the πMC: (1) inconsistency in its measurements; (2) automatic chord measurements do not relate to applicable particle dimensions unless spherical; (3) assumption of a general particle shape to describe individual particles is not valid; (4) distributions generated by this system are generally incomplete and instrument dependent; and (5) it does not correlate with sieve analysis or with microscopy (Zeiss) analysis. (auth)

9197 (ORNL-MIT—29) **Review of methods for measurement of drop size distribution in sprays and recommendations for the Spray and Absorption Technology Program.** Norelli, R.A.; Tripp, E.P. III. (Oak Ridge National Lab., Tenn. (USA)). 13 Oct 1967. 45p. Dep. NTIS $4.00.

Methods of measuring the size distribution of droplets in liquid sprays are reviewed. A photographic method in which fluorescent dye is first added to the liquid being sprayed is recommended for use in the Spray and Absorption Technology Program. Suggested equipment includes an automatic counting and sizing device for electronically scanning the photographic negatives. Alternatives are considered. (auth)

9198 (SAND—74-0087) **Sandia Laboratories technical capabilities: engineering analysis.** Lundergan, C.D. (ed.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 55p. Dep. NTIS $4.50.

This report characterizes the engineering analysis capabilities at Sandia Laboratories. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

9199 (SAND—74-0088) **Sandia Laboratories technical capabilities: testing.** Lundergan, C.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 36p. Dep. NTIS $5.00.

The testing capabilities at Sandia Laboratories are characterized. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

9200 (SAND—75-0491) **Wellbore thermal model.** Sullivan, W.N. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1970. Contract AT(29-1)-789. 22p. Dep. NTIS $4.50.

A finite difference model designed to predict the thermal behavior of drill holes during mud circulation is developed. The model includes well convection, local formation cooling, and transient effects. Preliminary numerical results with the program indicate that the downhole portion of the well may be cooled substantially, relative to the geological formation temperature, by the continuous circulation of drilling mud. (auth)

9201 (SAND—75-7088) **Review of downhole measurements while drilling.** McDonald, W.J.; Ward, C.E. (Maurer Engineering, Inc., Houston, Tex. (USA)). 15 Nov 1975. Contract AT(29-1)-789. 105p. Dep. NTIS $5.50.

For Sandia Labs., Albuquerque, NM.

There are large economic and technical incentives for measuring and telemetering data from downhole while drilling. These incentives include: improving overall drilling performance; improving safety through abnormal pressure detection and continuous monitoring of well control information; surveying and steering deviated holes; monitoring performance of downhole motors; continuous logging (for formation evaluation) while drilling; direct measurements for selection of coring intervals and casing seats; and improving planning of exploration and production wells. A practical, general purpose telemetry system is not yet available. While broad commercial availability is not expected within the next one to two years, prototype testing of systems is underway and limited availability of one or more systems is expected within two years. The methods presently used to measure drilling and formation parameters are reviewed. Different systems for transmitting borehole data which have been studied are categorized and described, and the basic advantages and disadvantages of each category are outlined. (TFD)

9202 (SAND—75-8044) **FY75 TCNT erosion test program development report.** Brown, M.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 105p. Dep. NTIS $5.50.

As a result of the successful FY74 transpiration-cooled nosetip (TCNT) erosion flight tests, a follow-up program was undertaken in FY75. The program was funded under a reimbursable contract by the Air Force as part of the Sandia/Air Force Material Study (SAMS) program. The objectives were to design and qualify a larger system than that developed in FY74 and flight test it in a naturally occurring storm. This report describes the design and qualification test results, which indicate that all system objectives can be met. (auth)

9203 (SAND—75-8059) **Nosetip recovery vehicle postflight development report.** English, E.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 279p. Dep. NTIS $9.25.

The nosetip recovery vehicle (NRV) was successfully flown on September 18, 1975. It was launched from Wallops Island, Virginia, on a STRYPI VII booster, which placed it at reentry conditions of V/sub E/ = 18,700 ft/s and γ/sub E/ = -25° at an altitude of 300,000 ft. Normal ballistic flight was continued until shortly after peak heating rate and peak deceleration had been experienced. The recovery process was then initiated at an altitude of approximately 28,200 ft. The recovery portion of the vehicle was "soft-landed" as planned and removed from the water about 2 1/2 h later by the Coast Guard Cutter Cherokee. This event marked the first time that a high-performance reentry vehicle had been soft-landed and recovered. The vehicle weighed 102 lb and had a ballistic coefficient of 2000 psf. The recovered portion, which weighed 40 lb, included the nosetip, most of the heat shield, and a portion of the telemetry/instrumentation. The vehicle was designed to fly trajectories typical of an intercontinental ballistic missile (ICBM). Fuzing functions for the recovery system were supplied by a dual-channel inertial fuze. The deceleration necessary to effect a soft landing was obtained by jettisoning about 60 percent of the vehicle mass, then deploying a two-stage parachute. A ram-air flotation bag and homing beacon on top of the main chute provided the additional capability for recovery from ocean areas. (auth)

9204 (UCID—16998) **Direct communication through a conducting medium.** Laine, E.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jan 1976. Contract W-7405-Eng-48. 8p. Dep. NTIS $3.50.

Direct communication at voice frequencies is possible through a conducting medium both along the surface and from the surface downward. A system being developed for such communication is briefly described. To date, the system has been demonstrated successfully in both earth and water media. (auth)

9205 (UCRL—50301) **Approximate solution of a spherical elastic solid in a viscoelastic hemispherical cavity.** Zaslawsky, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 May 1967. 21p. Dep. NTIS $3.50.

Declassified 16 Mar 1976.

An approximate solution is obtained for the stresses and the displacements in a viscoelastic foam when used to support the weight of a spherical elastic solid. From an extension of two-dimensional elastic plate theory, as well as several specified assumptions, and the uniaxial material behavior in compression of a viscoelastic foam, an approximate theoretical solution is obtained. The displacements were measured with linear variable differential transformers (LVDT's). The experimental results are in close agreement with the theoretical approximation.

9206 (UCRL—76804) **Computer-controlled access system: operational considerations.** Whitten, C.L.; Anderson, R.E; Victor, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Feb 1976. 9p. (CONF-760501—1). Dep. NTIS $3.50.

From Conference on crime countermeasures; Lexington, Kentucky, United States of America *USA* (5 May 1976).

Lawrence Livermore Laboratory has designed and implemented a computer-controlled personnel-access system capable of managing the access of some 12,000 people to a variety of areas involving different security requirements for admission. Hardware and software designs complement each other to provide a highly secure, extremely versatile access-control system. This paper describes the system, presents some of the options available, and discusses some logical extensions of the system to safety and administrative applications. 3 figures (auth)

9207 (UCRL—77095) **Nonlinear dynamic analysis of inflating axisymmetric membranes subjected to contact constraints.** Hallquist, J.O.; Feng, W.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Jun 1975. 22p. (CONF-760404—2). Dep. NTIS $4.25.

From 8. southeastern conference on theoretical and applied mechanics; Blacksburg, Virginia, United States of America *USA* (Apr 1976).

The exact governing equations of motion for finite deformations of hyperelastic membranes subjected to a contact constraint are derived from Hamilton's principle. The constraint condition is eliminated by introducing a slack coordinate as a new variable. An approximate solution to the resulting equations is sought by means of the Rayleigh-Ritz procedure in which a series of geometrically admissible continuous shape functions multiplied by unknown time dependent coefficients are assumed to define the deformed configurations. A set of nonlinear simultaneous differential equations are obtained and are solved by Newmark's method with Newton-Raphson iterations. As a consequence of the contact surface the inertial terms in the governing equations are nonlinear functions of the current displacements, velocities, and accelerations. A numerical example is presented in dimensionless form to demonstrate the effectiveness of the procedure.

9208 (SAND—76-6011) **Stressing-cement concretes in cast-in-place and precast construction.** Mikhailov, V.V.; Litver, L.S.; Karasev, A.K.; Budagyants, L.I.; Titov, Yu.N. 22 Dec 1975. Translation by B. Teague of Primenenie betonov na napryagayushchem tsemente v monolitnom i sbornomonolitnom stroitel'stve (obzor), Moscow, 1975. 89p. Dep. NTIS $5.00.

The review describes the properties of stressing cement and briefly relates the main processes causing it to expand during hardening. The book presents data on the use of stressing cement in various fields of construction, discussing the features of this type of cement and methods of preparing and curing stressing-cement concretes for various applications. Information also appears on the use of expansive and stressing cements in the U. S. This review is aimed at engineering staff workers in construction organizations, at construction workers, and designers and scientific researchers. (auth)

9209 (SAND—76-6013) **Cost optimal life test for components with exponentially distributed lifetimes.** Sellingschegg, D. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Systemanalyse). Jan 1976. Translation by P. Newman of KFK—2031. 65p. Dep. NTIS $4.50.

Thesis.

This work reports the determination of cost optimal plans for life tests. Plans of the type (n,infinity,r), (n,l,r), (n,infinity,T), and (n,l,T) are considered. The methods of alternative hypotheses, interval estimates and point estimates are used to make a statistical assertion based on test data. The aim of this work is to determine a plan in such a way that, for an optimal statistical decision procedure, the expected experimental cost is as low as possible for a given degree of efficiency for the statistical assertion. The investigation employs a cost model which considers the investment and operating costs of the test facility, the cost for the component to be tested and the cost (penalty or bonus) for meeting the specified contract length. (auth)

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 8483, 8718, 8924, 8970, 8986, 9282, 9287, 9288, 9289, 9290, 9291, 9292, 9293, 9296, 9299, 9607, 10018, 10020

9210 (ERDA-tr—92) **Pulsable superconducting 28 kJ solenoid magnet.** Juengst, K.P.; Obermaier, G. [nd]. Translation of German report. 17p. Dep. NTIS $3.50.

The design, construction, and testing of a pulsable superconducting solenoid magnet ("PUSSY") are described. The magnet has a cold bore of 80 mm diameter, and it reached a central field of 4.75 T after little training in the first run. The field homogeneity is 0.1 percent in 30 mm dsv and 1 percent in 60 mm dsv. The peculiarities of this solenoid are the fully insulated braid conductor, consisting of 32 multifilament wires with 206 NbTi filaments each, and the application of copper heat sinks for the cooling of the magnet windings. The magnet reached a rate of field change of 2 T/s or 630 A/s without significant degradation with respect to dc operation. The magnet is to provide a homogeneous magnetic field in a large working volume to measure frequency-dependent losses in superconductors. (auth)

9211 (ERDA-tr—86, pp 58-73) **Cryogenics engineering for low-temperature projects of the Institute for Experimental Nuclear Physics.** Katheder, H.; Lehmann, W.; Spath, F. (Institute for Experimental Nuclear Physics, Karlsruhe, Ger.). Jan 1975. Translated from German report.

In Reports of the Nuclear Research Center, Karlsruhe. 7th annual publication.

A discussion is given of the cryogenic engineering and installations required for superconducting devices used in particle accelerators. Closed He cooling circuits, with an integrated refrigerating plant and auxiliary equipment, were constructed for low temperature testing, and operational experience with the cooling systems is described. Also discussed are projects for a superconducting synchrotron at CERN and for resonant cavities and beam focusing magnets for the IEKP LINAC. (PMA)

9212 **Superconductivity: a subject of interest to the Atomic Energy Commission.** Stevens, D.K. (Atomic Energy Commission, Washington, DC). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 101-104(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The interests of the Atomic Energy Commission (now the Energy Research and Development Administration) in superconductivity include applications in: (1) high energy physics; (2) con-

trolled thermonuclear devices; (3) energy storage; (4) energy transmission; and (5) energy conversion systems. Some applied efforts centering on superconductivity technology are briefly discussed, and the research programs of the Materials Sciences Program of the Division of Physical Research are outlined. (PMA)

9213 Electric Power Research Institute's role in applying superconductivity to future utility systems. Rabinowitz, M. (Electric Power Research Inst., Palo Alto, CA). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 105-108(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Economics has been the single most important factor in determining the future of any new commercial technology in the United States. This criterion is in need of serious examination in view of the projected sharply increasing consumption of energy in the next few decades, particularly in the form of electricity. In order to make a smooth and meaningful transition from conventional methods of generating and transmitting electricity, a coordinated effort between all segments of the private and public domains will be required. The Electric Power Research Institute (EPRI) should play a vital role in planning for both the imminent short term, and long term national electrical energy needs; and in coordinating efforts to achieve these vital goals. If, as predicted, the U. S. power consumption increases by more than a factor of six in the next 30 years, it should be clear that it is necessary to develop high power density methods of producing and transmitting electricity. Superconductivity is the natural prime candidate for a new feasible technology that can take on this responsibility. (auth)

9214 Helium supply demand in future years. Laverick, C. (Argonne National Lab., IL). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 109-112(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Adequate helium will be available to the year 2000 AD to meet anticipated helium demands for present day applications and the development of new superconducting technologies of potential importance to the nation. It is almost certain that there will not be enough helium at acceptable financial and energy cost after the turn of the century to meet the needs of the many promising helium based technologies now under development. Serious consideration should be given to establishing priorities in development and application based upon their relative value to the country. In the first half of the next century, three ways of estimating helium demand lead to cumulative ranges of from 75 to 125 Gcf (economic study), 89 to 470 Gcf (projected national energy growth rates) and 154 to 328 Gcf (needs for new technologies). These needs contrast with estimated helium resources in natural gas after 2000 AD which may be as low as 10 or 126 Gcf depending upon how the federal helium program is managed and the nation's natural gas resources are utilized. The technological and financial return on a modest national investment in further helium storage and a rational long term helium program promises to be considerable. (TFD)

9215 Superconducting rotating machines. Smith, J.L. Jr.; Kirtley, J.L. Jr.; Thullen, P. (Massachusetts Inst. of Tech., Cambridge). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 128-134(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The opportunities and limitations of the applications of superconductors in rotating electric machines are given. The relevant properties of superconductors and the fundamental requirements for rotating electric machines are discussed. The current state-of-the-art of superconducting machines is reviewed. Key problems, future developments and the long range potential of superconducting machines are assessed. (auth)

9216 Development of niobium—copper-invar composite conductor for an ac superconducting power transmission cable. Beall, W.T. Jr. (Union Carbon Corp., Tarrytown, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 381-384(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

A superconducting ac power cable has been developed using Nb/Cu/Invar composite conductors and shields in a coaxial configuration with pressurized He at 4.7 K as the primary dielectric. Two major concerns for this cable system were the accommodation of fault currents and the differential thermal expansion between the conductor assembly and the cryogenic envelope. It was shown that a Nb/Cu/Invar composite tube is capable of accommodating the fault currents as well as the differential thermal expansion. Studies of the effect of surface finish on the ac losses showed that with proper surface finish, the losses can be reduced to an acceptable level for power cable applications. The lowest 60 Hz losses measured at a peak surface magnetic field of 0.1 T correspond to 43 W per 3-phase mile for a 138 kV, 3400 MVA power cable. (auth)

9217 Progress at Brookhaven in the design-cooled power transmission systems. Forsyth, E.B. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 393-396(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Following an extensive study of cryogenic power transmission systems under development in this country and abroad it was concluded at Brookhaven that a flexible superconducting ac cable appeared to be the best choice for an economical high-capacity underground system with superior technical characteristics. A form of niobium—tin has been developed for this application with an intrinsic low-loss performance at 60 Hz. In addition, it has been determined that the ac characteristics of many commercial forms of Nb_3Sn are degraded by additives; these effects are described. A flexible cable will require a lapped plastic insulation which must possess necessary properties both at room temperature and at the operating temperature; these are listed together with a summary of test results. Several designs for the cryogenic envelope to contain the cable are under development, the design options and trade-offs are discussed. Using performance data based on present knowledge of helium-cooled cables, systems were designed for an actual utility company transmission corridor 43 miles long rated at 4800 MVA. These designs are costed and compared to conventional transmission facilities. (auth)

9218 Effect of surface metallurgy on the penetration depth and rf breakdown field of superconducting niobium. Varmazis, C.; Luhman, T.S.; Joshi, A.; Kammerer, O.F.; Giordano, S.; Strongin, M. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 423-426(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The surface metallurgy of niobium is discussed, including factors such as impurity distributions at the surface and surface topography. Measurements of the penetration depth are presented both in the clean limit, where there is about a 20 A region of oxygen at the surface (after high temperature heat treatment) affecting the boundary condition on the GL order parameter; and in the dirty limit, where heating in an oxygen atmosphere near 10^{-6} torr can greatly affect the surface roughness. Auger measurements of the surface conditions in a 1 percent Zr in Nb alloy are also presented. A discussion is given of preliminary results in a special apparatus where rf breakdown experiments can be performed on small samples and correlated with the metallurgical factors mentioned above. (auth)

9219 Investigation of microwave properties of superconducting $Nb_{0.4}Ti_{0.6}$. Giordano, S. (Brookhaven National Lab., Upton, NY); Hahn, H.; Halama, H.J.; Luhman, T.S.; Bauer, W. *IEEE Trans. Magn.*; **MAG-11**: No. 2, 437-440(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

A superconducting $Nb_{0.4}Ti_{0.6}$ test cavity was constructed to measure the surface losses as function of frequency in the range from 2 to 8 GHz and as a function of temperature below 4.2 K. The temperature-dependent part of the surface resistance agrees essentially with the BCS theory if the material parameters T/sub c/ = 9.8 K, $\Delta(0) = 1.73$ k/sub B/T/sub c/, $x_{i_0} = 380$ A, lambda/sub L/ = 310 A, and l = 4 to 8 A are taken. The magnitude and frequency dependence of the temperature-independent residual resistance observed in the niobium titanium cavity suggests no difference in the behavior of type I and II superconductors. The highest $Q_o = 2.9 \times 10^9$ was measured in the TE_{011} mode at 3.9 GHz. A coaxial cavity with removable sample was constructed for an in-depth study of rf breakdown and its relationship with metallurgical parameters as characterized by ac loss, magnetization, and penetration depth measurements. Peak fields in solid type-II superconducting cavities are limited by their low thermal conductivity, suggesting the use of films, 0.01 to 0.1 mm thick, on pure niobium or copper. The highest magnetic field (120 G) was measured on a recrystallized sample, suggesting that the lower critical field, H/sub c1/, (for this sample 75 G) does not prevent the application of high-T/sub c/ type-II superconductors to microwave devices. (auth)

9220 Will superconducting magnetic energy storage be used on electric utility systems. Hassenzah, W.V. (Los Alamos Scientific Lab., NM). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 482-488(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

As the cost of fossil fuel has increased and the load factors on electric utilities have decreased, the need for efficient, reliable energy storage systems has increased. Although pumped hydro storage is now used extensively on those utility systems having the appropriate resources nearby, it is only 65 percent efficient. Superconducting magnetic energy storage, which promises to be more than 90 percent efficient and easily sited, may become a competitive energy storage technology. A comparison of the various energy storage systems is presented in terms of performance on electric power systems and cost. Emphasis is given to the various technologies involved in the development of large superconducting magnets. A brief review of the Los Alamos Scientific Laboratory program on superconducting magnetic energy storage is included. (auth)

9221 Superconductivity to the rescue. McCracken, R.J.; Richied, D.E.; Toohig, T.E. *IEEE Trans. Magn.;* **MAG-11**: No. 2, 551-554(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

There are many large, useful electromagnets in service in laboratories throughout the world that are faced with common problems: i.e., incipient failure due to age, ever present desire for higher fields, and staggering escalation of power costs. Conventional rewind is generally not feasible due to magnet configuration and continuing high operating costs. A unique engineering approach is presented for the modification of existing exciting coils to operate in a superconducting mode using proven state of the art techniques and considerable cost savings over the fabrication of new superconducting coil packages using more conventional coil packaging. Typical cost analyses show the attractive use of such proposals. (auth)

9222 Cooling of a system of superconducting magnets by means of pumped subcooled liquid helium. Vander Arend, P.C. (Cryogenic Consultants, Inc., Allentown, PA); Stoy, S.T.; Richied, D. *IEEE Trans. Magn.;* **MAG-11**: No. 2, 565-568(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

In the course of developing the refrigeration system for the Fermi National Accelerator Laboratory energy doubler, a new concept was developed for the cooling of long, superconducting magnet systems. The concept depends on: (1) the use of pumps for the transport of liquid helium and refrigeration; and (2) heat transfer between a stream of boiling helium and one of subcooled liquid helium for maintenance of a constant temperature of the fluid surrounding the magnet windings. In order to verify the validity of the concept, an experimental program at Fermilab was started. The experimental installation and some of the test results obtained during a number of test runs are described. (auth)

9223 Dense supercritical-helium cooled superconductors for large high field stabilized magnets. Hoenig, M.O.; Montgomery, D.B. (Massachusetts Inst. of Tech., Cambridge). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 569-572(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

An analytical model was developed of a dense, supercritical helium-cooled superconductor, stabili zed to withstand short-term instabilities. The model allows for the absorption of energy from transient instabilities and Joule heating during current sharing. Coolant heat transfer parameters are optimized with respect to geometry and superconductor critical temperatures. Data are presented to demonstrate the advantages of a novel extended surface conductor bundle. This work was directed at large, high-field magnets in the 5 to 9 Telsa range. Conceptual designs of a toroidal "Tokamak" coil of 6 meter minor diameter and a 10 m long x 2.5 m diameter saddle-wound MHD magnet are presented. (auth)

9224 Slow cycling flux pump using digital control. Droege, T.F. (Fermi National Accelerator Lab., Batavia, IL); Purcell, J.R.; Wang, S.T. *IEEE Trans. Magn.;* **MAG-11**: No. 2, 580-581(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

A slow cycling flux pump was constructed with digital logic driving a high power operational amplifier for control. Hall sensors allow closed loop control of the secondary currents, allowing switching of the heater driven power cryotrons at the optimum time. Operating efficiency of 87 percent was achieved. (auth)

9225 Adjacent conductor field corrections to high critical current short sample measurements. Miranda, G.A.; Rogers, J.D. (Los Alamos Scientific Lab., NM). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 582-585(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The critical current was measured of several superconductors to 24 kA in magnetic fields to 4.5 T. The samples were hairpin shaped with the straight section under test in a perpendicularly applied field. The proximity of the straight parts causes the field of the current in one leg to change the applied field in the other leg. The measured results were corrected for this adjacent conductor field (ACF), resulting in data for uniform applied fields. One conductor, used in a 300 kJ magnet, was a single-layer, edge-wound coil, rated near 9.8 kA using the uniform field data. Under test, the magnet reached 12.5 kA, giving no sign of approaching the critical current. The "excess current" is due to the field gradient across the conductor in this coil. One contribution is due to the variation of j/sub c/ with the field value within the conductor. A second contribution results from the position dependent anisotropy of the filaments. It may be convenient to choose the definition I/sub c/ to be the current at which the sample generates an electric field of 3.5 μV/m. If 46 μV/m were chosen, I/sub c/ would rise approximately 0.86 kA at 17 kG. (auth)

9226 Superconducting switches using radiation induced quenching. Schmieder, R.W. (Sandia Labs., Livermore, CA). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 590-593(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The use of penetrating radiation such as x-rays or high energy electrons to cause quenching of a superconducting short across an inductive energy store, thereby switching the persistent current into an external load, is examined. The basic equations describing this process within the two-fluid model are presented, and estimates of the size of megampere switches are made. The ratio of switching energy to switched energy is derived, and x-ray vs. electron impact quenching is discussed. Several geometries for practical switches are presented. (auth)

9227 Development of a superconducting switch for magnetic energy storage systems. Lindsay, J.D.G.; Blevins, D.J.; Laquer, H.L.; Miranda, G.A.; Rogers, J.D.; Swannack, C.E.; Weldon, D.M. (Los Alamos Scientific Lab., NM). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 594-597(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Some of the problems encountered in constructing superconducting switches for magnetic energy storage systems are discussed. Empirical rules are given which assure that a switch is driven fully normal when triggered, and some of the possible geometrical arrangements for switches are considered. Results of energy transfer experiments from 20 kJ and 300 kJ superconducting energy storage systems using superconducting switches are given. (auth)

9228 Coherent ac Josephson effect in a bulk granular superconducting system. Yu, M.L.; Saxena, A.M. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 674-677(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

A three-dimensional close-packed array of Josephson junctions was successfully produced in the form of a bulk granular superconductor. The granular system is a tightly compressed solid of small, oxide coated tin particles in the thousand A range. The three-dimensional array of Josephson junctions thus formed showed coherent Josephson oscillations when external rf radiation was imposed. Rf induced constant voltage steps were observed on its I-V characteristics at voltages a few thousand times the Josephson voltage $h\nu/2e$. The external rf radiation also induced stable dc voltages on unbiased bulk samples, suggesting a practical mode of microwave detection. The analogy of this bulk superconducting system with a magnetic spin system will be discussed. (auth)

9229 Effects of laser irradiation on weak link devices. Janik, R.; Morelli, L.; Cirillo, N.C. Jr.; Lechevet, J.N.; Gregory, W.D. (Georgetown Univ., Washington, DC). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 687-689(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Experimental results are presented on the effects of optical radiation impinging on superconducting weak links and films. In-house fabricated weak links of various materials showed a lowering of critical current values dependent on radiation intensity. Also, specially modified commercial SQUIDS showed a lowering of both dc bias and rf bias required for SQUID operation as the optical intensity was increased. The possibilities of using high T/sub c/ materials for SQUID fabrication and the tuning of these devices via optical irradiation are discussed. (auth)

9230 Reliable dc SQUID made with tunnel junctions. Clarke, J.; Goubau, W.M.; ketchen, M.B. (Univ. of California, Berkeley). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 724-727(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Dc SQUIDS of cylindrical geometry were fabricated using Nb—NbO/sub x/—Pb tunnel junctions. The SQUIDs can be thermally cycled repeatedly and cooled in the earth's magnetic field without significant loss of performance. Flux resolution of 3 x 10^{-5} $phi_0/\sqrt{Hz}$ above a frequency of 1 Hz was achieved through optimization of electronic circuitry and careful shielding. Fluctuations and drift in the temperature of the helium bath are found to be the major source of long-term SQUID noise. With a simple temperature stabilizer, drift was reduced to less than 8 x 10^{-5} phi_0/hr over a three hour period. (auth)

9231 Self-synchronous parametric amplification using Josephson junctions. Yu, M.L. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 804-806(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

A new way to use Josephson junctions for parametric amplification with phase control is proposed. The dc current bias of the junction is adjusted such that the Josephson oscillation automatically synchronizes with the input signal and oscillates at twice the signal frequency with the proper relative phase. The impedance of the junction then has a negative resistive component which can be used for amplification. Extension to other phase sensitive circuits is also discussed. (auth)

9232 Low frequency noise in Josephson junctions. Clarke, J.; Hawkins, G. (Univ. of California, Berkeley). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 841-844(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Using a high resolution SQUID voltmeter, measurements were made of the spectrum of low frequency voltage fluctuations across a thin-film Josephson tunnel junction biased at a constant current I greater than the junction critical current I/sub c/. The frequency dependence of the voltage spectrum $V^2(f)$ may be accurately represented by the power law $V^2(f)$ varies as f^{-1} over the frequency range of the data: 10^{-2} less than f less than 10 Hz. The dependence of the magnitude of the spectra at any single frequency upon the value of the bias current I and upon the sample temperature T supports the hypothesis that the observed voltage fluctuations arise from a modulation of the junction critical current I/sub c/ by equilibrium, thermodynamic temperature fluctuations in the active junction volume. The measurements were interpreted in terms of the semi-empirical theory of Clarke and Voss for the low frequency fluctuation spectrum of systems obeying a diffusion equation. This interpretation provides design criteria which may prove useful in reducing the level of long-term drifts in systems employing Josephson tunnel junctions. (auth)

9233 Low frequency noise in superconducting Sn films at the transition temperature. Clarke, J.; Hsiang, T.Y. (Univ. of California, Berkeley). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 845-847(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The noise power spectrum was measured for tin films evaporated on glass substrates biased at the transition temperature. The spectrum is close to 1/f between 0.1 and 1000 Hz. The noise is found to be correlated over a correlation length $(D/\pi f)^{1/2}$, where D is the diffusivity of tin film. Studies were also made of samples in which a thin layer of aluminum was predeposited before tin evaporation. The aluminum layer appears to greatly reduce the thermal boundary resistance between tin and the substrate. The amplitude of noise for such samples is greatly reduced below 10 Hz, where it is almost independent of frequency. These results are in accord with the thermal diffusion theory proposed by Clarke and Voss and should have important implications on future construction of superconducting bolometers. (auth)

9234 Phonon and quasiparticle dynamics in superconducting aluminum tunnel junctions. Smith, L.N.; Mochel, J.M. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *Phys. Rev. Lett.*; **35**: No. 23, 1597-1600(8 Dec 1975).

The effect of the 2Δ recombination phonons in modifying the effective lifetime tau/sub eff/ for quasiparticle recombination was determined for the first time in a double-junction experiment by comparing measurements taken both with and without a helium film covering the junctions. For a double junction made from evaporated aluminum films 300 A thick deposited on a glass substrate, it was found that tau/sub eff//tau/sub R/=8.6 plus-or-minus 1.1 in the absence of the helium film, and, at Δ/kT=6, tau/sub R/=1.4 plus-or-minus 0.1 μsec. (AIP)

PROTECTIVE STRUCTURES AND EQUIPMENT

REFER ALSO TO CITATION(S) 8643

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 8484

9235 MA-23-6000: underwater bilateral servo master slave manipulator. Vertut, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique); Charles, J. (Centre d'Etudes et de Recherche Technique Sous-Marines (CERTSM), 83 Toulon Naval (France)). pp 1-21, pt.Bx155 of In 2. International colloquium on the exploitation of oceans. Vol.6. Technical themes. Opening session. Paris, France; Association pour l'Organisation de Colloques Oceanologiques a Bordeaux ([nd]). (In French)

From 2. International colloquium on the exploitation of oceans; Bordeaux, France (1 Oct 1974).

The different types of manipulators, recent data on their dexterity and the underwater work possible with servo master slave manipulators are reviewed. The general specifications of the manipulator MA 23—6000 designed for the machine ERIC II are given. (FR)

9236 Criticality safety data applicable to processing Liquid-Metal Fast Breeder Reactor fuel. Lloyd, R.C.; Clayton, E.D. (Battelle-Pacific Northwest Labs., Richland, WA). *Nucl. Sci. Eng.*; **59**: No. 1, 21-26(Jan 1976).

Critical-experiment data are presented on a heterogeneous lattice of fuel rods comprised of uranium and plutonium oxides, clad with stainless steel, and moderated with (U + Pu) nitrate solution, a condition not unlike that encountered in a fuel-element dissolver operation. The effect of a soluble neutron absorber (gadolinium nitrate) on the criticality of this type of system was also examined for its possible use as a method of criticality prevention and control during the dissolution step. The results provide data for code validation, an essential requirement on complex systems such as this, if the calculations are to be utilized to prescribe subsequent control limits under similar or related conditions in fuel processing. Experiments indicate (for the very limited data presented) that a heterogeneous system composed of these fuel rods in water can have a larger buckling than the fuel in the dissolved state. The question is, whether a fuel rod of a size different from that used in these experiments, immersed in fissile-bearing solutions, might have a still higher buckling (and smaller critical size) than the highest achievable buckling for fuel rods of optimum diameter and spacing in water. This important consideration regarding the criticality safety aspects of dissolvers must be examined in each case. The results of calculations of these systems with the KENO Monte Carlo code utilizing ENDF/B-III cross sections are presented. (auth)

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 8323

9237 (SAND—76-5039) Full scale vehicle testing program. Yoshimura, H.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. 24p. (CONF-760104—3). Dep. NTIS $3.50.

From Annual meeting of the transportation research board; Washington, District of Columbia, USA (19 Jan 1976).

Sandia Laboratories has been requested by ERDA to conduct a series of spent fuel shipping cask accident tests to evaluate the ability of large shipping casks (22.7×10^3 to 66.0×10^3 kg range) (25 to 75 ton) to maintain integrity under extremely adverse environments. This paper describes the three proposed accident scenarios and the development of an experimental program to measure cask impact parameters. Two railroad equipment and one motor truck accident tests will be conducted. Analytical studies and scale model tests will be performed for each accident test. Engineering measurements will include photometric coverage to show rigid body motion and deformation and measurement of acceleration and strain in the cask and vehicle. (auth)

9238 (RDT-F—7-2T(Amend.1)(1-5-76)) **Preparations for sealing, packaging, packing, and marking of components for shipment and storage. Amendment 1.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). 5 Jan 1976. 4p. RSO.

The amendment consists of pages 13 and 14 of RDT-F-7-2T. An editorial change has been made in paragraph 6.1.1. (TFD)

LASERS

REFER ALSO TO CITATION(S) 9141, 9576, 9981, 10036

9239 (SAND—75-5798) **Electron-beam excitation of gas lasers.** Gerardo, J.B.; Ramirez, J.J.; Gerber, R.A.; Patterson, E.L.; Prestwich, K.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 30p. (CONF-751108—15). Dep. NTIS $5.00.

From 1. international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

Gas-laser-excitation with intense relativistic electron beams has gained popularity through many successful demonstrations of efficient conversion of electron-beam energy to laser energy. In some instances, electron-beam excitation of gas lasers has resulted in record laser energy and/or power, in higher efficiencies than has ever been obtained with any other excitation scheme, and in the discovery of lasers that have not been produced by any other excitation schemes. The feature of electron beams that make this laser excitation scheme so promising for use in high-power lasers is the high-power capability of electron beams. Three electron-beam geometrical configurations have been applied to gas-laser-excitation; electron-beam coaxial with the laser axis, electron-beam perpendicular to the laser axis, and radial convergent electron-beams. Measurements and comparisons with theory for these three geometries are given. (auth)

9240 (UCID—16993) **Dynamics of trivalent rare earth molecular vapor lasers.** Krupke, W.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1976. Contract W-7405-Eng-48. 41p. Dep. NTIS $4.00.

Radiative transition probabilities in neodymium bearing vapors are reviewed and calculations are extended to visible laser transitions in terbium bearing vapor. Nonradiative relaxation processes in the pure and complexed halides are treated in greater detail. While precise, quantitative relaxation probabilities cannot be calculated on the basis of information presently available, plausibility arguments can be established which indicate the order of magnitude of relevant nonradiative decay probabilities. Reference to solid and liquid state nonradiative relaxation data for rare earth ions is reviewed to support the plausibility arguments for the vapor state. Having established the likelihood of high fluorescence yields in the vapor phase, various methods of laser pumping are discussed: optical pumping via parity allowed 4f-5d transitions; optical pumping via charge transfer bands of the vapor complex; and direct electron beam pumping. (TFD)

9241 **HF chemical lasers.** Jensen, R.J. (Los Alamos Scientific Lab., NM). pp 53-70 of In Progress in lasers and laser fusion. Perlmutter, A. (ed.). New York; Plenum Press (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P2.

The design, operation, and suitability of HF lasers for driving compression fusion reactions are reviewed. (TFD)

9242 **X-ray and γ-ray lasers.** Chapline, G.; Wood, L. (Lawrence Livermore Lab., CA). pp 269-280 of In Progress in lasers and laser fusion. Perlmutter, A. (ed.). New York; Plenum Press (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P2.

The possibilities of producing coherent radiation at wavelengths lambda less than 10 A are discussed. (TFD)

9243 **Late-time behavior of an iodine photodissociation laser oscillator.** Gusinow, M.A.; Freeman, J.R. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; **46**: No. 2, 796-801(Feb 1975).

The principal experimental result is a determination of late-time lasing long after the flashlamp output has terminated. A simple model has been constructed which agrees qualitatively with the experimental results. The calculations indicate that diffusive transport may be responsible for the observed late-time lasing. (auth)

9244 **Conversion efficiency and pulse shortening of a frequency-tripled, sub-nanosecond, 1.064 μm pulse.** Attwood, D.T.; Pierce, E.L.; Coleman, L.W. (Univ. of California, Livermore). *Opt. Commun.*; **15**: No. 1, 10-12(Sep 1975).

Single pulses from a mode-locked Nd laser are frequency tripled in a cascade process to provide a 3547 A probe for holographic interferometry of laser-produced plasmas. Overall energy conversion in excess of 30 percent and directly measured pulse shortening of 24 percent are reported for KDP crystals with an incident intensity of 10^9 W/cm^2. (auth)

9245 **Time-resolved output spectrum from a hydrogen fluoride laser using mixtures of SF_6 and HI.** Greiner, N.R. (Los Alamos Scientific Lab., NM). *IEEE J. Quant. Electron.*; **QE11**: No. 10, 844-845(Oct 1975).

The time-resolved spectrum from a transverse-discharge hydrogen fluoride (HF) laser using a mixture of SF_6 and HI is reported. Because this spectrum matches that from a high-pressure H_2-F_2 laser, and because the SF_6-HI mixture is chemically stable, this laser should be a suitable and convenient source for probing H_2-F_2 amplifiers. (auth)

9246 **Metal atom oxidation laser.** Jensen, R.J.; Rice, W.W.; Beattie, W.H. (to Energy Research and Development Administration). US Patent 3,916,338. 28 Oct 1975. Filed date 13 May 1974. 8p.

A chemical laser which operates by formation of metal or carbon atoms and reaction of such atoms with a gaseous oxidizer in an optical resonant cavity is described. The lasing species are diatomic or polyatomic in nature and are readily produced by exchange or other abstraction reactions between the metal or carbon atoms and the oxidizer. The lasing molecules may be metal or carbon monohalides or monoxides. (auth)

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 8548, 8619, 8699, 9173, 9194, 9195

9247 **An introduction to the calculation of continuous heat exchangers. Chapter 18.** Lecocq, P. (Electricite de France, 75 - Paris. Direction de l'Equipement); Llory, M.; Quinet, J.-L. (Electricite de France, 78 - Chatou. Direction des Etudes et Recherches). pp 951-1025 of In Fluid mechanics applied to equipment and energy problems. Hug, Michel (ed.). Paris, France; Eyrolles (1975). (In French)

Metallic continuous heat exchangers are discussed and are classified according to the field of application. Heat transfer modes are reviewed (radiation, conduction, convection), but the convective modes more frequent in continuous exchangers are emphasized (natural or forced convection with or without phase changes in the fluids involved). The pressure drop calculation is given, and the thermal and hydraulic aspects are stressed. (FR)

9248 (SC-RR—71-0658) **Time domain deconvolution technique for the correction of transient measurements.** Bickle, L.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1971. 225p. Dep. NTIS $14.25.

The preparation of α, β, and γ PdI_2 is described. Structural parameters of α and β PdI_2 are given. (JGB)

9249 (AEC-tr—7295, pp 100-103) **Experimental test-bed D1-P for testing models of heat exchangers.** Pulyaev, V.F.; Russiyanov, A.F.; Yushko, V.A. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

This test bed is for the heat-transfer and hydrodynamic testing of models of condensers, regenerative evaporators, gas regenerators, and cassettes of nuclear reactors operating with the dissociating heat-transfer medium N_2O_4. The test bed operates on the closed-vapor cycle and includes all the heat-exchanger elements. The test bed and its operation are described. (DLC)

9250 (AEC-tr—7295, pp 148-152) **Special computing system for simulating thermophysical properties of dissociating heat-transfer medium.** Shadskii, V.M. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

An analog-to-digital function converter, capable of working in conjunction with an analog computer, was developed for simulating the thermophysical properties of dissociating N_2O_4. Disassociating N_2O_4 may be used as a heat transfer medium in nuclear power plants. Circuit diagrams of the function generator of two variables and of three variables are presented and procedures for making calculations are described. (LCL)

9251 (AEC-tr—7295, pp 199-209) **Experimental study of convective heat transfer in the dissociating gases.** Devoino, A.N. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Past experimental investigations on the convective heat transfer in disassociating N_2O_4 are described, and problems which must be solved by future experimental studies are enumerated. (LCL)

9252 (AEC-tr—7295, pp 210-215) **Quasifrozen flow criteria for dissociating gas.** Reisig, V.A.; Shchegolev, G.M. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

A method of determining the range of parameters characterizing the flow of disassociated gas with frozen composition is suggested. The case considered is of practical importance for the cooling or heating of the gas in slit-type heat exchangers, porous or perforated walls, in supersonic nozzles, shock waves, etc. (auth)

9253 (AEC-tr—7295, pp 224-232) **Heat and mass transfer with chemical changes in reacting boundary layer.** Sergeev, G.T.; Tarasevich, L.I. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Experiments performed to measure heat and mass transfer with chemical changes in a reacting boundary layer are discussed. The experimental apparatus consisting of a constant—action low-velocity wind tunnel, a porous metal plate, water cooling system, pressure controls, thermocouples, ethyl alcohol or hexane as the reacting fluid, and flow meters is described. Empirical relations are developed which approximate the average heat and mass transfer data. (LCL)

9254 (AEC-tr—7295, pp 233-248) **Calculation of the parameters of chemically reacting flow through a heated channel.** Nesterenko, V.B.; Tverkovkin, B.E.; Shinkevich, O.S.; Pleshchenkov, G.A. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Past experimental studies indicate that the use of the chemically reacting N_2O_4 system as a heat transfer medium and working fluid in nuclear power plants with gas-cooled reactors is feasible, but further work on the use of this system has been hampered because no simple and reliable method is available which can be used for the engineering calculations of gas-cooled reactors and heat exchangers working on a chemically reacting heat transfer medium. A one-dimensional model was selected for the calculation of chemically reacting flow through the heated channel of a reactor, and a solution is presented to the problem of calculating the mean parameters of the chemically reacting flow. (LCL)

9255 (AEC-tr—7295, pp 249-260) **Solution of some problems of thermophysics by approximation method.** Gribkova, V.P. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Approximate solutions to the problems of steady-state and transient thermal conductivity in chemically reacting gas flow are presented. (LCL)

9256 (AEC-tr—7295, pp 261-267) **Calculation of flow parameters upon condensation of the system $2NO+O_2$ in equilibrium $2NO_2$ in equilibrium N_2O_4 in a tube.** Mikhalevich, A.A.; Nesterenko, V.B.; Novikov, G.G. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Using a one-dimensional analytical model, the change in parameters upon condensation of the system $2NO + O_2$ reversible $2NO_2$ reversible N_2O_4, of which the reaction $2NO + O_2$ reversible $2NO_2$ is mainly a nonequilibrium reaction and the constituents NO and O_2 are noncondensing gases in the practical range of temperatures and pressures, is considered. (auth)

9257 (AEC-tr—7295, pp 268-275) **Experimental investigation of heat transfer with phase change of chemically reacting heat-transfer media.** Kolykhan, L.I. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Heat transfer in disassociating systems was investigated experimentally with N_2O_4 boiling in a horizontal tube under conditions of natural convection at pressures from 2 to 10 atm and thermal loading up to 4×10^5 kcal/m² x h and in a vertical tube under conditions of natural circulation at pressures of 2 to 50 atm and thermal loading of from (3.5 to 17) x 10^4 kcal/m² x h. Although the absolute values of the heat transfer coefficients varied, a correlation between the coefficient of heat transfer and the coefficient of pressure peculiar to N_2O_4 was observed in all experiments. It was concluded that available experimental data are insufficient for reliable recommendation for the calculation of heat transfer coefficients with change of phase in chemically reacting systems. (LCL)

9258 (AEC-tr—7295, pp 276-283) **Evaporation of liquid droplets in a medium of variable properties.** Dregalin, A.F.; Bychenok, V.I. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

In order to determine the evaporation rate of liquid fuel in a flow of high-temperature gas, the size distribution of the droplets, conditions of the surrounding gas flow, thermophysical properties of the evaporating constituent in liquid and vapor phases, and the properties of the gas must be known. A system of equations is presented, the solution of which will enable demonstration of the effect of variable composition and properties of the gas on the evaporation rate of the liquid droplets. (LCL)

9259 (AEC-tr—7295, pp 284-288) **Results of experimental investigations of heat transfer in boiling nitrogen tetroxide in a vertical tube.** Bakalin, Yu.I.; Golubenko, G.G.; Kolykhan, L.I.; Sen'ko, A.S.; Solov'ev, V.N. 1975. Translated from Dissotsiiruyushchie gazy kak teplonositeli i rabochie tela energeticheskikh ustanovok, Nauka and Tekhnika Press, Minsk, 1970.

From All-union conference on dissociating gases as heat transfer media and working fluids in power installations; Minsk, USSR (27 Jan 1969).

In Dissociating gases as heat-transfer media and working fluids in power installations.

Heat transfer for disassociating N_2O_4 during boiling in a vertical tube under conditions of natural circulation were studied. Data on the effects of heat flux and pressure on the coefficient of heat transfer are presented. The investigations indicated that heat transfer in boiling chemically reacting systems differs from the heat transfer in boiling inert pure substances. Therefore, care should be taken in calculating the coefficient of heat transfer for the reacting system, on the basis of the existing criterial and empirical correlations. (LCL)

9260 **SUPERCRITICAL WING SECTIONS II. A HANDBOOK.** Bauer, F.; Garabedian, P.; Korn, D.; Jameson, A. Contract AT(11-1)-3077. Lecture Notes in Economics and Mathematical Systems, Volume 108. New York; United States of America (USA); Springer-Verlag New York Inc. (1975). 301p. (COO—3077-80).

9261 **Thermal diffusivity measurement by a radial heat flow method.** Donaldson, A.B. (Sandia Labs., Albuquerque, NM); Taylor, R.E. *J. Appl. Phys.*; **46**: No. 10, 4584-4589(Oct 1975).

A method is presented whereby the thermal diffusivity of a solid is measured by observing the temperature excursion which results from a radial flow of heat. The radial heat flow is produced by the instantaneous deposition of energy on a disk region of one surface of a planar specimen. Experimental results which utilized this technique are presented for Armco iron and they are compared to results based on an axial heat flow method with a radial heat flow correction. (auth)

MATERIALS TESTING

REFER ALSO TO CITATION(S) 8964, 9210

9262 (BNWL-SA—5595) **Quality control program for 100% inspection using non-destructive measurements.** Hooper, R.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 8p. (CONF-751113—10). Dep. NTIS $3.50.

From 1. ERDA statistical symposium; Los Alamos, New Mexico, USA (3 Nov 1975).

A quality control program is developed for the acceptance of individual items where 100 percent inspection is accomplished using a non-destructive measurement system. The program is a function of the measurement system's response to defects of a known size (standards), measurement precision and a continuing plan for demonstrating that the measurement system is in control. (auth)

9263 (CEA-CONF—3053) **Localization of acoustic emission sources. Possibilities and limits.** Asty, M.; Bernard, P.; Monier, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Feb 1975. 21p. (In French). INIS.

From Meeting on acoustic emission; Lyon, France (17 Mar 1975).

It is necessary to dispose of a system capable of data acquisition and processing in real time. The coordinates of emissive sources must be calculated either immediately after the detection of information or after a brief storage time. Emphasis is given to the various parameters liable to affect the measurement precision: transducers (type, selectivity, form of signal), threshold device (dynamics, influence on the precision), screening device (influence on the number of data received). Four-transducer patterns are now in common use: square; centered equilateral triangle; and lozenge mesh. Each geometry possess zones of indetermination. The accuracy on the coordinates of the source varies according to the position of this source with respect to the four-transducer mesh, which leads to a case-by-case study of the arrangement and dimensions of the meshes placed on the structure to be observed. Detection and localization equipment must be designed as a whole system flexible and easy to adapt to any structure. (FR)

9264 (SAND—75-5790) **Application of unloaded (FREE) motion measurements and mechanical impedance to vibration testing.** Smallwood, D.O. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 12p. (CONF-760411—2). Dep. NTIS $3.50.

From Proceedings of the institute of environmental sciences; Philadelphia, Pennsylvania, United States of America "USA" (25 Apr 1976).

Methods using blocked force measurements with apparent weight data to derive test specifications are well known. These methods are used infrequently because it is difficult to acquire valid blocked forced measurements directly. Not as well known are similar techniques using unloaded (free) motion measurements, which are frequently much easier to acquire. The purpose of this paper is to review these methods and to suggest several applications including: (1) the determination of the input force to a test item mounted on a nonrigid test fixture when only the force input to the fixture can be measured; (2) the measurement of the foundation apparent weight when it is not possible to drive the foundation at the load point directly; (3) derivation of the test item motion from the foundation unloaded motion, the foundation apparent weight, and the test item apparent weight; and (4) prediction of the load response from apparent weight measurements and the motion of the foundation with a different load. Also discussed are methods for applying the results to sinusoidal, transient, and random vibrations.

9265 (TID—26977) **Experimental determination of strains at high temperature.** Durelli, A.J.; Buitrago, J. (Catholic Univ. of America, Washington, D.C. (USA). Stress Analysis Lab.). Oct 1975. Contract W-7405-eng-26. 75p. Dep. NTIS $4.50.

For Oak Ridge National Lab., TN.

Great technical difficulties have to be overcome to determine strain fields when loaded bodies are subjected to temperatures of the order of 1100°F for long periods of time. Progress made in the development of three methods used, moire, grids, and indented dots is summarized. The strain-analyzed specimen is an in-plane loaded stainless steel plate with a central hole. Loads were sufficiently large to produce elastic, plastic and viscoelastic deformations. Sufficient results have been obtained to show the feasibility of the approaches followed and to be in a position to verify independent structural solutions, but the precision of the determinations and the time required for the evaluation are considered not satisfactory. Some details of the techniques employed and recommendations to improve them are included. (auth)

9266 (AEC-tr—7315, pp 162-169) **Photographic intensiometry of γ-radiation in radiography.** Serebrennikov, I.Ya.; Karavaev, S.P.; Sul'kin, A.G.; Firstov, V.G. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The use and performance of scintillation counters for calibrating γ exposures for γ radiography are described. (WHK)

9267 (AEC-tr—7315, pp 177-186) **Method for the preparation of reference symbols for radiography.** Chubkov, V.N.; Solntsev, V.V.; Chupkov, V.M.; Zotov, A.I. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

A method for the preparation of symbols for marking radiographs is described. (TFD)

9268 (AEC-tr—7315, pp 192-195) **Some results of the exploitation of the γ-flaw detector "Trassa".** Khoroshev, V.N.; Maiorov, A.N.; Galash, T.F. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

Quality control of welded joints in gas and oil pipelines using the "Trassa" flaw detector is described. (TFD)

9269 (AEC-tr—7315, pp 207-212) **Hose γ-flaw detector "Kama" with a powerful radiation source.** Mairov, A.N.; Grachev, A.V.; Kuleshov, A.V.; Galkin, S.G.; Naugol'nykh, B.L.; Goncharov, V.I.; Lopatin, V.V.; Sakhanov, A.S. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The design and operating parameters of the "Kama" flaw detector are described. The detector uses a ^{60}Co source and is used to inspect articles with complex configurations, building constructions, and joints and components located in places inaccessible with conventional-type equipment. (TFD)

9270 (AEC-tr—7315, pp 212-217) **Economic effectiveness of the introduction of new types of γ-flaw detectors in industry.** Komarova, Yu.P.; Akopov, V.S. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

A review of the technico-economic effectiveness of new and advanced types of gamma flaw detectors introduced into the USSR industry is presented. The detectors examined include Gasprom, RID-21, Labirint, Trassa, Neva, Polyus, Stapel, RID-22, Arktika, and Kama. (TFD)

SAFETY ENGINEERING

9271 (UCRL—5007-75-1, pp 25-27) **Decontamination: enhanced filtration.** 15 Aug 1975.

In Hazards control progress report No. 50, January—June 1975.

A HEPA-filter service life measurement system is described. (GHT)

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 9231, 10044

9272 (AEEW-M—1296) **Design and testing of a superscreened cable-MM10/75.** Fowler, E.P. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Nov 1975. 21p. Dep. NTIS (US Sales Only) $3.50.

Design features of a superscreened cable in which newly developed techniques for metal tape winding are used to achieve good screening and good flexibility are described. These are applied to a general purpose low noise (anti-microphonic) cable which has an onerous mechanical specification. Test results on production samples are given before and after mechanical working. (auth)

9273 (BDX—613-1434) **Electrical conductivity study of etched-out plated-through holes in double-sided printed wiring boards.** Setter, R.J. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1976. Contract AT(29-1)-613. 23p. Dep. NTIS $4.00.

A proposed method for producing nonplated-through holes in double-sided printed wiring boards has been proved not detrimental to the functioning of the boards. Electrical conductivity measurements of holes which had been drilled, plated through with copper, and subsequently etched out to produce nonplated-through holes indicated negligible conductance in the range from 1 to 6 picomhos 1 to 6 pS. (auth)

9274 (CEA-CONF—3058) **Precise determination of a statistical value by a set of automatical measurements. Example of realization.** Allard, G.; Kermorgant, J.; Lenoir, S.; Raoult, N.; Ringeard, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 1975. 13p. (In French). (CEA-SES-INT-SGM—75-84). INIS.

From International colloquium on electronics and measuring methods; Paris, France (26 May 1975).

Most of the estimation and qualification operations carried out by the test laboratory of the CEA centralized administration group (GEC) make use of a measurement system programmed by a mini-computer. By its ability to link up operations sequentially and memorize the data collected, the computer can introduce a statistical approach into the evaluation of a result. A set of n measurements carried out with the same apparatus may be considered as the n determinations of a random variable and the main characteristics, average value, standard deviation of the series thus obtained can define such concepts as correctness and accuracy. This approach to the measurement introduces statistical testing with its related notion of confidence limits. A special effort was made to reduce the programming time to a minimum and to simplify link-ups between the existing system and instruments from different sources. The measurement apparatus is linked to the computer through a modular interconnection system, the standard CAMAC. This consists of functional elements in the form of racks corresponding to dimensional and electrical norms, which can be combined in a standardized chassis. The transfer of data between the computer and the chassis is standardized which reduces the number of subroutines necessary to organize these exchanges. As a result they can easily be included in complex languages (FORTRAN, BASIC) and this cuts down the programming times considerably.Several programmes are operational, particularly those concerning voltage sources, impulse circuits and digital voltmeters, and many evaluations of electronic equipment have been carried out with these automatic systems since 1971. (FR)

9275 (HMI-B—182) **Computer aided production of manufacturing CAMAC-wired boards by the multiwire-technique.** Martini, M.; Brehmer, W. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany). Bereich Datenverarbeitung und Elektronik). Oct 1975. 27p. (In German). Dep. NTIS (US Sales Only) $4.00.

The multiwire-technique is a computer controlled wiring method for the manufacturing of circuit boards with insulated conductors. The technical data for production are dimensional drawings of the board and a list of all points which are to be connected. The listing must be in absolute co-ordinates including a list of all soldering points for component parts and a reproducible print pattern for inscription. For this wiring method a CAMAC standard board, a layout plan with alpha-numeric symbols, and a computer program which produces the essential technical data were developed. A description of the alpha-numeric symbols, the quality of the program, recognition and checking of these symbols, and the produced technical data is presented. (auth)

9276 (SAND—75-0304) **Influence of lead frame thickness on the flexure resistance and peel strength of thermocompression bonds.** Johnson, D.R.; Willyard, D.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 25p. Dep. NTIS $3.50.

The flexure resistance and peel strength of 0.18 mm and 0.25 mm thick lead frames, which were thermocompression bonded to metallized ceramic substrates, were determined. Comparison was made on the basis of existing bonding thermodes with parameters varied to yield a range of bond zone deformations extending from 20 to 65 percent. Bond strength was evaluated through a 90° peel test, while flexure resistance was determined through a cycle of 30° flex and return with a 200 g deadweight attached to the lead. Results of this study indicate that: (1) the flexure resistance of thermocompression bonded 0.18 millimeter leads was significantly greater (at least 50 percent increase in cycles to failure) than that for 0.25 millimeter leads; (2) the flexure resistance for both lead frame thicknesses decreased with increasing bond zone deformation; (3) tool configuration, especially rail edge radius, is a major contributing factor in the flexure resistance of lead frame bonds; and (4) consistently high peel strength was more easily maintained with 0.18 mm leads. (The 0.25 millimeter leads exhibited a greater sensitivity to bonding parameters which resulted in both very high and very low peel strength values.) The results were further compared to those from a previous investigation of 0.13 and 0.18 mm lead frames with regard to bondability and flexure resistance. The combined data from the two separatestudies reveal that the 0.18 mm leads yielded an increase in flexure resistance of 80 and 53 percent over the 0.13 and 0.25 mm thick leads respectively. (auth)

9277 (SAND—75-0485(Rev.)) **Bibliography: Sandia Laboratories hybrid microcircuit and related thin film technology (revised).** Oswalt, J.A. (comp.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 61p. Dep. NTIS $4.50.

Sandia originated documents (94) describing aspects of technology development related to hybrid microcircuits and thin films are summarized. Authors, titles, and abstracts are given for each unclassified document. The papers are categorized according to the various technologies involved in hybrid microcircuit production. (auth)

9278 (UCRL—77271) **Computer-aided design of separable two-dimensional digital filters.** Twogood, R.E.; Mitra, S.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1975. 8p. (CONF-751109—10). Dep. NTIS $3.50.

From 9. annual asilomar conference on circuits, systems and computers; Pacific Grove, California, USA (3 Nov 1975).

A procedure for the design of separable two-dimensional digital filters is presented. The computation involved in both the filter design and implementation is shown to be efficient. Several examples are presented which illustrate the application of the technique. 6 figures. (auth)

PARTICLE ACCELERATORS

9279 **Proceedings of the 1975 particle accelerator conference: accelerator engineering and technology, Washington, DC, March 12—14, 1975.** *IEEE Trans. Nucl. Sci.*; NS-22: No. 3, 1905-1992(Jun 1975).

DESIGN, DEVELOPMENT, AND OPERATION

9280 (LA—6109-PR) **Medium-Energy Physics Program progress report, February 1—April 30, 1975.** (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-eng-36. 110p. Dep. NTIS $5.45.

Operation, modifications, and research efforts at the Clinton P. Anderson Meson Physics Facility (LAMPF Linac) are reported. A large maintenance effort was made in cleaning and upgrading the rf system, and numerous improvements were made in the beam injection, monitoring, and transport systems. Advancements were made on beam dynamics problems, and optics calculations and design studies resulted in a number of hardware improvements. The major accomplishment of the reporting period was the completion of the shimming and the mapping of the Energetic Pion Channel and Spectrometer (EPICS). Current and future experimental work is described. (PMA)

9281 (UCID—16746) **Preliminary studies on accelerator development program.** Reginato, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1975. Contract W-7405-Eng-48. 11p. Dep. NTIS $3.50.

A study was made of the Abramyan type accelerator using a scale model to investigate the resonant transformer principle and the beam induced voltages. The Abramyan technique of resonant transformer charging an accelerating gap was found to work very well. The circuit is quite simple, the components values are not critical, and only a low voltage primary capacitor and a single switch are needed to generate a high secondary voltage. (PMA)

9282 **ESCAR: first superconducting synchrotron, storage ring.** Elioff, T.; Gilbert, W.S.; Lamberston, G.R.; Meuser, R.B. (Univ. of California, Berkeley). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 447-450(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The ESCAR (Experimental Superconducting Accelerator Ring) project is an accelerator technology development for which the primary goal is to obtain design and operational experience with a complete accelerator and storage ring system utilizing superconducting magnets. Full scale design effort began in July 1974, and operation is planned in 1977. ESCAR will not only provide the experience of fabricating and operating an extensive cryogenic magnet system with a significant advancement beyond present experience, but it will also provide a comprehensive accelerator system from which can be learned the realities of the interaction between the new cryogenic elements and the many other components of an accelerator. The extent to which these components (e.g., rf, injection, vacuum, control systems, etc.) are compatible with the cryogenic features of the accelerator, and to which they force modifications of the design, will be determined. (auth)

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 8339

9283 (JINR—P11-9108) **Investigation of nonlinear resonance (ν/sub x/ = 2/3) of third order by the Krylov—Bogolyubov method in the second approximation.** Amirkhanov, I.V.; Vasilev, V.K.; Zhidkov, E.P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The third order resonance (ν/sub x/ = $^2/_3$), which was used for primary beam extraction from the JINR synchrophasotron, was studied. Shortened equations were obtained by the Krylov-Bogolyubov method in the second approximation. A complete investigation was made of these equations. (tr-auth)

9284 (ORNL-tr—4071) **Second-order directional focusing of charged particles in magnetic fields.** Hintenberger, H. Translated by E.G. Silver from *Z. Naturforsch., a;* **3a**: 669-670(1948). 3p. Dep. NTIS $3.50.

The conditions are given under which a divergent bundle of charged particles of identical energy and mass, emanating from a single point, can be gathered together again in a single point to second order after being bent in a homogeneous magnetic field. (PMA)

9285 (ORNL-tr—4070) **Magnetic cylindrical lenses with corrected image error.** Hintenberger, H. Translated by E.G. Silver from *Z. Naturforsch., a;* **3a**: 125-127(1948). 5p. Dep. NTIS $3.50.

The use of cylindrical electromagnetic lenses for ions and electrons is discussed, and it is shown that, by a suitable choice of the shape of the pole pieces, it is possible to achieve exact focusing. The equation for the radius of curvature is given, and, from the field boundary equations for exact focusing, it is easy to derive the conditions for focusing to any desired order. (PMA)

9286 **Filamentary instability of a relativistic electron beam.** Molvig, K. (Physics Department, University of California, Irvine, California 92664). *Phys. Rev. Lett.*; **35**: No. 22, 1504-1507(1 Dec 1975).

The transverse electromagnetic or filamentary instability is reconsidered in light of recent experiments which were unable to suppress the instability by increasing the beam transverse temperature. It is found that only the applied magnetic field can stabilize the mode. While the beam temperature can cause stabilization in a collisionless, ν=0, plasma, for finite ν the beam is unstable to filamentation if ω/subp//subb/$^2\beta^2\gamma > \Omega$/subc//sube/^{2} regardless of its temperature. (AIP)

AUXILIARIES AND COMPONENTS

REFER ALSO TO CITATION(S) 9211, 9222

9287 (ERDA-tr—86, pp 17-24) **Pulsed superconducting magnets.** Turowski, P. (Institute for Experimental Nuclear Physics, Karlsruhe, Ger.). Jan 1975. Translated from German report.

In Reports of the Nuclear Research Center, Karlsruhe. 7th annual publication.

Details of the status and current problems of a pulsed superconducting magnet program are given. An additional heat source in pulsed magnet operation is due to hysteresis and eddy current losses, causing difficulties in magnets for high energy particle accelerators. A dipole magnet was constructed to investigate possible loss reductions, and its operation, design, and performance are discussed. (PMA)

9288 **Superconductivity applications in high energy physics.** Fields, T.H. (Argonne National Lab., IL). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 113-118(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

During the past five years, several very large superconducting bubble chamber and spark chamber magnets became operational. The economic and other factors which have led to the construction of large superconducting solenoid magnets for high energy physics research are discussed, and the technological development which made these magnets possible is summarized. Much of the recent development work on superconducting magnets for high energy physics was directed toward the next generation of accelerators and beam storage rings. Here, the goal is to develop dipole and quadrupole magnets of high field precision, low cost, high reliability, capability for slow pulsing, and minimal sensitivity to radiation heating. The status of this work and its application to future accelerators is described. Also, the application of superconducting rf cavities for linear accelerators and particle separation is reviewed briefly. (auth)

9289 **High-performance Nb helical cavity.** Benaroya, R.; Clifft, B.E.; Johnson, K.W.; Markovich, P.; Wesolowski, W.A. (Argonne National Lab., IL). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 413-416(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

A 92-MHz superconducting-Nb helix resonator of exceptional quality was thoroughly tested under a variety of conditions. The unit is a full-scale lambda/2 structure with dimensions appropriate for heavy-ion acceleration. When operated at a temperature of 1.8°K and with bare (not anodized) Nb surfaces, the low-field Q is 9.4×10^9, equivalent to a surface resistance of 5×10^{-10} ohms. The maximum surface magnetic field is 1200 G and the maximum surface electric field is 37 MV/m, which corresponds to a traveling-wave axial accelerating field of 4.6 MV/m. These characteristics set new performance standards for helix resonators. A systematic study of the effects of various surface treatments, including abuses of the cavity, is described. The tests consist of 24 liquid helium cool-downs, at 4.2°K and 1.8°K, of the cavity with bare and anodized Nb surfaces which at various times were electropolished, oxypolished and heat treated. Rf and helium conditioning are discussed as techniques to get through multifactoring barriers and extend the maximum obtainable electric field. (auth)

9290 **Results of magnet prototype evaluation for the Fermilab Energy Doubler project.** Strauss, B.P.; Sutter, D.F.; Ioriatti, E.; Habrylewicz, W. (Fermi National Accelerator Lab., Batavia, IL). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 451-454(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

The magnet fabrication and testing program was initiated in September 1972, operated the first test magnets in January 1973, settled on a shell type geometry by June 1973, tested and evaluated a matched set of dipoles by November 1973 and operated the first 6 meter, or "20 ft", prototype dipole by March 1974. The 20 ft dipole did not perform satisfactorily, reaching less than 50 percent of design current and exhibiting excessive training. Consequently, a redirection of the program channeled further efforts into a 2.5 ft model program to identify and correct the sources of difficulty and to enable resumption of 20 ft prototype construction. The first phase of the 2.5 ft program included the construction and testing of 12 magnets and is essentially complete. It led to the promise of an improved wire and a slightly more conservative magnet design that is now being used in the construction of $2^1/_2$ and 10 ft models. While the 2.5 ft model program was in active progress,

two additional 20 ft prototype dipoles of the original design and one 7 ft quadrupole were completed. (auth)

9291 High field superconducting magnets for accelerators and particle beams. Allinger, J. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 463-466(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Experience in designing precision superconducting magnets for fields up to 60 kG is described, and realizable construction tolerances and their impact on field accuracy is discussed. For dipole fields up to 60 kG or more, rectangular coil window frame type magnets are compared with circular or elliptical coil designs. In all cases, the same superconductor current density versus maximum field performance is assumed. The comparison includes field quality and correction required as a function of aperture size, stored energy, ampere turns required, and overall magnet size. In quadrupole design, the impact of the allowed superconductor current density being roughly inversely proportional to peak field is severe. For gradients up to one Tesla/cm or greater, similar comparisons for different types of quadrupole construction are made. (auth)

9292 Operating experience with a superconducting magnet in a primary proton beam. Allinger, J.; Danby, G.; DeVito, B.; Hsieh, S.; Jackson, J.; Prodell, A. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 467-470(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Two superconducting dipole magnet modules were operated successfully at BNL since October 1973 to bend 30 GeV/c protons from the AGS by 8° in the new North Area beam to the 7-ft. Bubble Chamber. The magnets were energized for over 1000 hours, and, of that time, were traversed by the proton beam with beam intensities up to 5 x 10^{12} protons per pulse for about 750 hours. Operation of these series connected magnet units (each 2 meters long) at 35 kG was routine, even when they were intermittently subjected to beam heating of several hundred joules per pulse due to other operational beam difficulties. Experiments were also performed where copper blocks were inserted 2 meters upstream, resulting in very large interaction rates in the beam tube inside the units. A magnet quench occurred with target thicknesses such that energy approaching 1kJ per pulse was being absorbed in the system. (auth)

9293 Fermilab cryogenic energy storage system. Mills, F.E. (Fermi National Accelerator Lab., Batavia, IL). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 489-492(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

A superconductive magnetic storage system was designed to smooth the pulsating power requirement of the Fermilab accelerator. The system stores 1 MWh and operates at peak power level of 200 MW on a 10 sec cycle. The magnetic system employs cryogenically stable superconductors and a flux-forcing normal secondary. The power system uses phase controlled thyristor rectifier-inverters similar to those employed in the main accelerator power supply. (auth)

9294 LAMPF experimental-area beam current monitors. Tallerico, P.J. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Vac. Sci. Technol.*; **12**: No. 6, 1200-1202(Nov 1975).

This paper summarizes the design and operational performance of a wide- range current monitor system used to measure charged-particle currents in the experimental areas of the Clinton P. Anderson Meson Physics Facility (LAMPF), a proton accelerator. The major features of the system are high sensitivity, wide dynamic range, and the ability to withstand high levels of radiation. The current pulses detected are from 50 μs to 1 ms in duration at repetition rates of from 1 to 120 Hz. The pulse amplitude varies from 1 μA to 17 mA of protons or H^- ions. Both real-time and integrated outputs are available, and the minimum detectable currents are 1 μA at the video output and 50 nA at the integrated output. The basic system is comprised of toroids, preamplifiers, signal conditioners, voltage-to-frequency converters, and digital accumulators. The entire system is spread out over 1 km of beam pipe. Provision is made for calibration and for sending the outputs to remote users. The system is normally controlled by a small digital computer, which allows the system to be quite flexible in operation. The design features of the toroids and the associated electronics are discussed in detail, with emphasis on the steps taken to reduce noise and make the toroids temperature and radiation resistant. (AIP)

ION SOURCES

9295 (LBL—4210) **Heavy ion source development at the Bevatron.** Richter, R.M.; Zajec, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 7p. (CONF-751048—4). Dep. NTIS $3.50.

From International conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

The Bevatron 20 MeV duoplasmatron source is currently being modified with the goal of producing 1 mA of $^{20}Neon^{3+}$. Initial tests at 420 keV show a total beam of 20 mA of which 400 μA is $^{20}Neon^{3+}$. The quantity of beam in various charge states is determined with a pulse field magnetic spectrometer. Titanium sublimation and cryogenic pumping of the PIG source in the High Voltage Terminal and its resultant effects on the acceleration of carbon and nitrogen are discussed. (auth)

INJECTION AND EXTRACTION SYSTEMS

REFER ALSO TO CITATION(S) 9283

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 9471

9296 Engineering design and analysis of large superconducting particle analysis magnets. Heim, J.; Fast, R. (Fermi National Accelerator Lab., Batavia, IL). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 471-474(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Superconducting magnet technology is one phase of applied superconductivity where significant electrical power savings may be appreciated. Furthermore, these power savings may be gained without sacrificing reliability of operation or initial capital costs. The design and construction are described of 4 large superconducting dipole magnets which are being used at Fermi National Accelerator Laboratory to conduct high energy physics experiments. Two of these magnets were built and operated continuously for several months prior to installation in beam lines. Two larger superconducting dipoles are presently under construction, and both magnets will be completed this year. All magnets are designed to operate continuously without special attention, consuming approximately 10 percent of the power which would be demanded by a conventional magnet. (auth)

9297 Batch process for the production of ^{13}N-labeled nitrogen gas. Austin, S.M.; Galonsky, A.; Bortins, J. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.); Wolk, C.P. (Michigan State Univ., East Lansing (USA). MSU;AEC Plant Research Lab.). *Nucl. Instrum. Methods*; **126**: No. 3, 373-379(15 Jun 1975).

A technique was developed for generating $^{13}N^{14}N$ gas with specific activity 20 mCi/ml. The ^{13}N is produced, nearly free of other radioactivities, in the $^{13}C(p,n)^{13}N$ reaction, using 17 mg amorphous carbon targets enriched to about 97 percent ^{13}C and a proton bombarding energy of 11 MeV. The irradiated material is converted to $^{13}N^{14}N$ gas by automated Dumas combustion and compressed into 1 ml vials, the entire procedure taking less than 15 min. A number of biological tests showed that the $^{13}N^{14}N$ gas is essentially free of other labeled compounds of nitrogen. The advantages and disadvantages of other ^{13}N-producing nuclear reactions are discussed. (auth)

STORAGE RINGS

REFER ALSO TO CITATION(S) 9282

9298 (ERDA—1546(DRAFT)) **Environmental statement: positron-electron storage ring project.** (Stanford Linear Accelerator Center, Calif. (USA)). Jan 1976. vp. W.H. Pennington, Environmental and Safety, Washington, DC.

An environmental impact statement is presented for the proposed Positron-Electron colliding beam Project (PEP), a project consisting of a storage ring and experimental halls to be located at SLAC. Environmental considerations discussed include: (1) visual impacts; (2) electric power requirements; (3) the radiological impact; (4) the impact of additional laboratory staff; (5) erosion and drainage; (6) noise control; (7) ecology; (8) traffic control; (9) economic stimulation; and (10) cultural impacts. Alternatives to the project are also discussed, including alternative sites and design. (PMA)

9299 **Magnets for the ZGS superconducting stretcher ring.** Purcell, J.R.; Wang, S.T.; Niemann, R.C.; Mataya, K.F.; Kudwig, H.; Biggs, J.A. (Argonne National Lab., IL). *IEEE Trans. Magn.*; **MAG-11**: No. 2, 455-458(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Dipoles and quadrupoles were developed for use in a 12.5 GeV storage ring at the ZGS. The winding bore of these magnets is 10.16 cm with a useful aperture of 7.6 cm. The magnets produce a high quality field (+-0.1 percent nonuniformity including the ends) that requires no correction at any field level. An operating current of 190 A at the design field of 30 kG allows the use of a very low heat leak cryostat design. A 3 meter length of magnets is expected to require only 2 liters of helium per hour. Construction of 5 prototype modules, consisting of 2 dipoles and 1 quadrupole each, complete with cryostats, is almost completed. (auth)

9300 **Measurement of the radiative electron polarization in a 2.4-GeV storage ring.** Camerini, U.; Cline, D.; Learned, J.; Mann, A.K.; Resvanis, L.K. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174 and Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev., D*; **12**: No. 7, 1855-1858(1 Oct 1975).

We have observed the existence of transverse polarization of the electron beam in the SPEAR storage ring resulting from the emission of synchrotron radiation in the magnetic field. The time constant for polarization build-up has been measured for a single circulating electron beam to be approx. 90 min and the corresponding equilibrium polarization to be approx. 0.85. These values are to be compared with the theoretical predictions of 124 min and 0.924, respectively. (AIP)

INSTRUMENTATION

REFER ALSO TO CITATION(S) 9100

RADIATION INSTRUMENTATION

REFER ALSO TO CITATION(S) 9228

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 9266, 9469

9301 (BNL—20720) **Position sensing by charge division.** Alberi, J.L.; Radeka, V. (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1975. 15p. (CONF-751116—24). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A summary of a comprehensive analysis of theoretical and practical aspects of position sensing by charge division from resistive electrodes is presented. Properties of transformer decoupling of the resistive electrode from detector bias voltage are analyzed and compared to the usual capacitive decoupling methods. Optimization and limitiation of signal shaping is discussed as a function of diffusion time constant, signal rise times, and notes. (auth)

9302 (COM—75-10342) **Semiconductor measurement technology: improved infrared response technique for detecting defects and impurities in germanium and silicon p-i-n diodes. Final report.** Sher, A.H. (National Bureau of Standards, Washington, D.C. (USA)). Feb 1975. 29p. (NBS-SPEC.PUBL.—400-13). NTIS $3.75.

An infrared response (IRR) technique was evaluated for its utility in qualifying germanium for radiation detector use. Because of several improvements in the sensitivity and interpretation of the technique made during the evaluation, it was possible to observe a number of discrete energy levels lying within the forbidden energy gap of germanium which had passed unobserved in previous studies. These levels correlate with the type of defects and vacancies introduced by radiation damage into germanium as measured using such techniques as photoconductivity and Hall effect measurements after irradiation. Furthermore, the improved infrared response measurement method was used to identify impurities, such as copper, gold, and iron, and dislocations resulting from heat treatments in germanium. A major advance was made when it was determined that the IRR spectra could be grouped into five distinct types on the basis of spectral features observed in the energy range from 0.6 to 0.7 eV. (GRA)

9303 (GJO—1656) **Development of an atmospheric ^{214}Bi measuring instrument.** (Geodata International, Inc., Dallas, Tex. (USA)). 7 Nov 1975. Contract AT(05-1)-1656. 52p. Dep. NTIS $4.50.

Part of the radiation environment encountered during airborne gamma ray surveys is produced by ^{214}Bi existing in the atmosphere. The ^{214}Bi atmospheric concentration changes with time and location, and should be measured to process the acquired data correctly. Three methods of atmospheric ^{214}Bi measurement are evaluated in this work. These are: (1) an 11½'' dia. x 4'' thick NaI(Tl) crystal shielded from ground radiation, (2) a negatively charged wire to collect radioactive ions, and (3) a high volume air sampler collecting particulate matter on filter paper. The shielded detector and filter paper methods yield good results with the shielded detector producing a factor of about 10 times higher counting rate. The charged wire method gave very low counting rates where the shielded detector counting rates were about a factor of 100 times higher, and the results did not correlate with the ^{214}Bi atmospheric concentration as determined by the other two methods. The theory necessary to understand the collection and decay of the airborne radioactivity using the charged wire and filter paper methods is developed. (auth)

9304 (ORNL-TM—5222) **One- and two-dimensional least-squares smoothing and edge-sharpening method for image processing.** Bell, M.R. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 37p. Dep. NTIS $5.00.

A rapid method is developed for two-dimensional smoothing and edge-sharpening by the least-squares fitting of a function to a limited area of the data. This convolution or matrix weighting is applied at each point of the data set to yield a smoothed or a sharpened image. Weighting matrices for 3 x 3, 5 x 5, and 7 x 7 point fitting areas are provided for polynomial function fits of all degrees up to the highest degree determinable. For the 7 x 7 point fitting area weights for fitting functions of up to the quartic in both dimensions are supplied. Application of the 5 x 5 point quadratic fit smoothing to a nuclear medicine image is shown as an example. (auth)

9305 (RDT-C—15-11T(12-75)) **BF_3 gamma tolerant neutron detector tubes.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). Dec 1975. 19p. RSO.

This standard covers the requirements for a high gamma tolerant, BF_3 filled proportional counter (also called detector) for use in neutron detection systems requiring operation in gamma flux environments to 10^3 R/hr. This standard applies only to the detector; however, when used with other appropriate standards or specifications, it is intended that more complete assemblies (integral detector and cable or special shielded systems) can be obtained. Required performance characteristics are detailed, and the tests to assure this performance are described. (auth)

9306 (UCRL—76894) **Theoretical band structure analysis on possible high-Z detector materials.** Yee, J.H.; Sherohman, J.W.; Armantrout, G.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. 11p. (CONF-751116—11). Dep. NTIS $4.25.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

Theoretical energy band structure calculations have been utilized to investigate several high-Z materials for potential use as ambient temperature radiation detectors. Using the pseudopotential technique, the band structure for HgI_2 has been determined and the effective masses of the holes and electrons have been estimated. Theoretical mobilities of the electrons and holes as a function of temperature have been computed for HgI_2 and CdTe and are compared to experimental data. (auth)

9307 **Gamma sample changer: Mod. II (3 Dec 1974) (Engineering Materials).** (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE—2413).

123 drawings.

The Gamma Sample changer is a manual or totally automatic (computer operated) sample changer and analyzer which holds 16 samples. These samples are manually loaded in various types of holders. An intermittent motion conveyor mechanism automatically positions samples over a left mechanism. Samples are then raised and positioned a certain distance from the face of a shielded detector. The height of the sample or distance from the detector is automatically determined by the gamma flux level of the sample. A programmed height index drum locates the sample very accurately for analyzing. Photo diode type shaft incoders are utilized in identifying samples, programming and recording data. (auth)

9308 Automation of data collection and computation functions for monochromatic x-ray absorption analysis (31 Aug 1971) (Engineering Materials). (Oak Ridge Y-12 Plant, Tenn. (USA)). (CAPE—2414).

4 drawings.

A system for simplifying and speeding up the analysis of monochromatic x-ray absorption is described. The previous method in use required close attention to the operation of the x-ray instrument and extensive manual calculation to obtain the results. Measurement of the absorption of x rays at wavelengths on either side of an absorption edge of the element of interest was accomplished using an x-ray spectrometer as a means of selecting the desired x-ray wavelengths. The x rays passing through the sample in a preset time were counted by a scintillation detector and associated electronics. Calculation of the element concentration by a derived x-ray absorption equation involved the difference of the logarithms of ratios of x-ray counts through water to x-ray counts through the sample at two wavelengths. With manual desk calculators and logarithm tables, much time was required and many opportunities for error were present. In order to simplify and speed up the analysis, a small, dedicated computer was interfaced to the spectrogoniometer and scalar units of the x-ray instrument. The computer controlled the functions of setting the spectrogoniometer angles, starting and stopping the scalers, accepting the scaler data, calculating the sample results, and printing these results in final form via teletype. Supplementary software was provided for calculating the necessary constants in the x-ray absorption equation. (auth)

9309 (AEC-tr—7315, pp 75-82) **Stabilization of voltage and discrimination level for a scintillation data-unit in β-ray detection.** Mashinin, V.A.; Salakhov, A.M. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The plateau in the counting characteristics of scintillation detectors for beta detection is studied. It was found that there is a plateau both for the voltage of the photomultiplier and the registration threshold. (WHK)

9310 (AEC-tr—7315, pp 116-123) **Gauge for pulse neutron fluxes.** Kir'yanov, G.I.; Kozma, A.S.; Kosorotov, N.A. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

A proton-recoil polystyrene scintillation detector for measuring fast neutron fluxes in the range 10^6 to 10^{11} neutrons/sec is described. (WHK)

9311 (AEC-tr—7315, pp 144-148) **Reversing pulse counter based on decatrons of a new type.** Isaev, V.S.; Lavrent'ev, Yu.D.; Mamikonyan, S.V. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

A circuit diagram and specifications are given for the pulse counter for use in x-ray radiometric equipment. (WHK)

9312 Theory of correlation measurement in time and frequency domains with ^{252}Cf. Mihalczo, J.T.; Pare, V.K. (Oak Ridge National Lab., TN). *Ann. Nucl. Energy;* **2**: 97-105(1975).

The theory of cross-correlation measurements between the pulses from an ionization counter containing a ^{252}Cf neutron source, which furnished the initiators of fission chains in a neutron-multiplying assembly, and the pulses from a detector observing the particles from the fission chains is reviewed. The expression for the detector response in this type of measurement is first presented in the time domain. Then the cross-power spectral densities in the frequency domain measurements are developed. The theory of the usual two-detector noise measurement is reformulated to incorporate a modified Diven factor that includes the effects of neutrons from external sources such as spontaneous fission of the californium and the reactor fuel. Finally, the equivalence between both the time and frequency domain expressions is demonstrated. A new method of reactivity determination is proposed which avoids some of the difficulties of the present methods, such as dependence on detection efficiency and inherent source strength, and the requirement for a calibration near delayed criticality. (auth)

9313 Dependence of the Ge(Li) efficiency slope on the source-to-detector distance. Grant, P.M. (Los Alamos Scientific Lab., N.Mex. (USA)). *Nucl. Instrum. Methods;* **127**: No. 3, 371-372(15 Aug 1975).

The slope of the linear portion of a Ge(Li) log(efficiency) vs log(energy) plot varies with the source-to-detector distance and crystal geometry. Such considerations should be remembered when applying the empirical function which related this slope to the detector geometry. Such considerations should be remembered when applying the empirical function which relates this slope to the detector active volume. (NL)

9314 Gamma ray camera system with corrugated collimators. Muehllehner, G. (to G. D. Searle and Co.). US Patent 3,921,000. 18 Nov 1975. Filed date 7 May 1973. 7p.

A gamma ray camera system, such as an Anger-type camera, fitted with a collimator comprising an arrangement of straight and corrugated strips of lead foil is described. One embodiment comprises a parallel multichannel collimator employing corrugated strips with regular, parallel corrugations. A second embodiment comprises a focusing multi-channel collimator employing corrugated strips having corrugations which focus substantially to a common point and are generally wider and deeper on the side more remote from said common point. (auth)

9315 (RDT-C—10-3T(Rev.)(12-75)) **Multiple input preamplifier/discriminator for use with neutron counters.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). Dec 1975. 20p. RSO.

This standard covers a multiple input preamplifier/discriminator for use with neutron counters where it is desired to combine the counter signals. It presents the required performance and the tests to determine this performance. The preamplifier is of the charge sensitive type and performs required pulse shaping. Each preamplifier feeds a separate discriminator. Each discriminator has a remote adjustment with optional internal adjustment, and all discriminator outputs are summed at the cable driver stage. (auth)

RADIATION DOSEMETERS

9316 (BNL—20762) **Composite damage track-albedo personnel neutron dosimeter for general use.** Distenfeld, C.H. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 7p. (CONF-760202—25). Dep. NTIS $3.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

No known detector or series of detectors in personnel neutron dosimeters have correct dose equivalent energy-dependence. Useful dosimeter performance is assumed by calibrating dosimeters for the exposure spectrum. This method implies that the exposure spectrum will be constant within a given facility or the wearer will not be exposed to different spectra in other areas. Since exposure spectra are known to vary widely a composite damage track-albedo personnel neutron dosimeter was developed to separately respond to the softer and more energetic parts of various spectra. The relationships of the responses of the elements vary with different spectra and are used to convert dosimeter readings to dose equivalent. Measurements indicate that dose equivalent deviation was less than approximately 50 percent for unshielded lucite and steel shielded HPRR spectra, monoenergetic spectra from 4.7 to 15 MeV, a ^{252}Cf spontaneous neutron spectrum and an AmBe spectrum. Dosimeter sensitivity was similar to present NTA film methods. The composite personnel neutron dosimeter was also tested with calculated spectra by simulating badge response through known energy-dependence of the badge elements. Dose equivalent deviation was less than approximately 20 percent for 19 significantly different assumed spectra. Thus, the experimental and calculational results support adherence to the dose equivalent for common exposure spectra. (auth)

9317 (ORNL—5046, pp 53-56) **Dosimetry intercomparison studies.** Becker, K.; Fox, W.F.; Burke, G.deP.; Gesell, T.F.; Dickson, H.W.; Haywood, F.F.; Ward, D.R. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics reported on include nuclear accident dosimetry, personnel monitoring intercomparison, and international intercomparison of environmental dosimeters under field and laboratory conditions.

9318 (ORNL—5046, pp 59-63) **Dosimetric applications of particle-track etching.** Becker, K.; Jun, J.S.; Abdel-Razek, M. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Spark counting of particle tracks in mica, spark counting of neutron-induced recoil particle tracks, and transfer dosimeters for fast neutron sources are discussed. (WHK)

9319 (ORNL—5046, pp 65-68) **Exoelectron and thermoluminescence dosimetry with BeO.** Becker, K.; Huskey, L.; Cheka, J.S.; Kerr, G.D.; Crase, K.; Jun, J.S.; Gammage, R.B. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Beryllium oxide is one of the most potentially useful materials, in the tissue-equivalent range, as a solid-state integrating dosimeter. It is hoped to exploit its use both as a thermally stimu-

lated exoelectron (TSEE) and as a thermoluminescent dosimeter (TLD), particularly in situations where other types of integrating dosimeters are nonexistent or inadequate. This material also exhibits unique characteristics in its response to nonionizing radiation. Research is reported. (WHK)

9320 (ORNL—5046, pp 254-255) **Some operating characteristics of tissue-equivalent proportional counters.** Shonka, J.J.; Gritzinger, C.M.; Poston, J.W. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

The chemical composition of A-150 tissue-equivalent Shonka plastic is given, and characteristics of a Shonka plastic proportional counter for neutron dosimetry are discussed. (WHK)

9321 (ORNL-TM—4786) **1974 intercomparison of personnel dosimeters.** Dickson, H.W.; Fox, W.F.; Haywood, F.F. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 20p. Dep. NTIS $5.00.

An intercomparison of personnel monitoring dosimeters was conducted at Oak Ridge National Laboratory' DOSAR Facility during the period May 14-16, 1974. Ten independent laboratories and companies participated in an intercomparison of neutron and gamma-ray dosimeters used for routine personnel dosimetry. The dosimeters, which were sent through the mail, were exposed at the Health Physics Research Reactor to the same three "standardized" radiation fields which have been used for the past several years for intercomparing nuclear accident dosimeters. In addition, a 14-MeV neutron field was used as a fourth exposure configuration. The results of the intercomparison show widely varying dose estimates. The average of the reported values of neutron dose equivalent, for example, has standard deviations ranging from 47–102 percent. (auth)

9322 **Phosphor for thermoluminescent radiation dosimeter.** Nada, N.; Yamashita, T. (to Matsushita Electric Industrial Co., Ltd.). US Patent 3,920,998. 18 Nov 1975. Priority date 29 May 1970, Japan. 4p.

Phosphor composed primarily of BeO and more than 0.5 percent and up to 10 percent by mole of at least one activator selected from the group consisting of lithium, sodium and potassium is prepared by mixing a raw material high purity beryllium oxide with at least one kind of the activators of lithium, sodium and potassium and sintering the resulting mixture in a covered crucible at a temperature of 1,500°C to 2,100°C for 3 to 24 hours and is used for a thermoluminescent radiation dosimeter. The material can exactly measure the radiation dose up to a high level such as 1,000 to 2,000 roentgens. (auth)

NUCLEAR SPECTROSCOPIC INSTRUMENTAION

REFER ALSO TO CITATION(S) 10032

9323 (ORNL—5046, pp 75-78) **Dosimetry for terrestrial gamma-ray sources.** Abdullah, S.A.; Dickson, H.W.; Kerr, G.D.; Miah, M.F.K.; Perdue, P.T. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Dose rates from natural radionuclides and ^{137}Cs in soils of the Oak Ridge area have been determined from in situ and core sample measurements. Information on soil composition, density, and moisture content and on the distribution of cesium in the soil was obtained from the core samples. Measurements of radionuclide concentrations in the samples were made with a 4 x 4 in. NaI detector. Gamma-ray spectroscopy using a lithium-drifted germanium (GeLi) detector has been applied to the determination of radionuclide concentrations in soil and the associated gamma dose rates above the earth plane. An unshielded GeLi detector placed about 1 m above the earth detects gamma radiation from an area of about 100 m^2. The equipment and data processing procedure are briefly described. (WHK)

9324 **Radioactivity observed in the sodium iodide gamma-ray spectrometer returned on the Apollo 17 mission.** Dyer, C.S.; Trombka, J.I.; Schmadebeck, R.L.; Eller, E. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center); Bielefeld, M.J. (Computer Sciences Corp., Las Vegas, Nev. (USA)); O'Kelley, G.D.; Eldridge, J.S.; Northcutt, K.J. (Oak Ridge National Lab., Tenn. (USA)); Metzger, A.E. (Jet Propulsion Lab., Pasadena, Calif. (USA)); Reedy, R.C. (Los Alamos Scientific Lab., N.Mex. (USA)). *Space Sci. Instrum.;* **1**: No. 3, 279-288(Aug 1975).

In order to obtain information on radioactive background induced in the Apollo 15 and 16 gamma-ray spectrometers (7 cm x 7 cm NaI) by particle irradiation during spaceflight, an identical detector was flown and returned to earth on the Apollo 17 mission. The induced radioactivity was monitored both internally and externally from one and a half hours after splashdown. When used in conjunction with a computation scheme for estimating induced activation from calculated trapped proton and cosmic-ray fluences, these results show an important contribution resulting from both thermal and energetic neutrons produced in the heavy spacecraft by cosmic-ray interactions. (NL)

9325 **Lorentz factor for triple-axis spectrometers.** Pynn, R. (Brookhaven National Lab., Upton, N.Y. (USA)). *Acta Crystallogr., Sect. B;* **31**: No. 10, 2555-2556(15 Oct 1975).

An expression for the Lorentz factor relevant to a triple-axis neutron spectrometer is presented. The expression relates the structure factor of a Bragg peak to the integrated intensity obtained with any scan which passes through the Bragg point and which follows a linear path in reciprocal space. The important exact result obtained here is that the Lorentz factor is the same for double-axis spectrometers when theta-2 theta scan is used and when the sample is a single crystal with a narrow mosaic. (NL)

9326 **Some studies of reflector construction and electronics configurations for optimizing pulse-height and pulse-shape resolution in alpha liquid-scintillation spectrometry.** McKlveen, J.W. (Arizona State Univ., Tempe); McDowell, W.J. *Nucl. Technol.;* **28**: No. 1, 159-164(Jan 1976).

Various sample sizes, reflector sizes and shapes, and reflector materials were examined to determine their effect on pulse-height and pulse-shape resolution in alpha liquid-scintillation spectrometry. A section of a metal sphere coated with a diffuse-white reflective material was found to have the best characteristics for both pulse-height and pulse-shape resolution. Although sample volumes as large as 10 ml could be tolerated when used with reflectors to accommodate them, the best results were obtained with 1-ml samples and smaller reflectors. Comparison of two types of pulse-shape discrimination circuitry for separating alpha and beta-gamma pulses indicated that a zero-crossover method was superior to a constant fraction timing method. The combination of these improved detectors with solvent extraction methods of incorporating the sample in the scintillator and pulse-shape discrimination allows alpha spectrometry with a background as low as 0.01 count/min and an energy resolution as high as 5.5%. (auth)

HIGH ENERGY PHYSICS INSTRUMENTATION

9327 (ORNL/TM—5162) **Calculated response of a liquid-scintillator total-absorption hadron calorimeter.** Santoro, R.T.; Amburgey, J.D.; Gabriel, T.A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 19p. Dep. NTIS $5.00.

The calculated performance of a large-volume, all-liquid-scintillator calorimeter for incident pions having momenta in the range of 3 to 20 GeV/c is presented. The calculated scintillation pulse-height distribution, energy deposition, leakage energy, and pulse-height resolution as a function of pion energy are given. Calculated and experimental pulse-height distributions are compared for 20-GeV/c incident pions. (auth)

9328 **Application of classical theory of electrons in gases to drift proportional chambers.** Palladino, V. (European Organization for Nuclear Research, Geneva (Switzerland)); Sadoulet, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Instrum. Methods;* **128**: No. 2, 323-335(1 Oct 1975).

It is shown that it is possible to understand both qualitatively and quantitatively, in the framework of the classical theory of electrons in gases, the behavior of drift velocities in gases commonly used in proportional drift chambers. Argon-isobutane mixtures are studied in detail and the contribution of diffusion to the spatial resolution and the modification of drift velocities in magnetic fields are especially commented on. (NL)

9329 **Practicable discrimination of rapidly moving electric and magnetic charges.** Hagstrom, R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **35**: No. 25, 1677-1678(22 Dec 1975).

A method of discriminating between rapidly moving electric and magnetic charges is proposed. The scheme relies on detection of the polarization of Cherenkov radiation. (AIP)

RADIOMETRIC INSTRUMENTS

9330 (BNL—20718) **Instrument for bone mineral measurement using a microprocessor as the control and arithmetic element.** Alberi, J.L.; Hardy, W.H. II. (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1975. 8p. (CONF-751116—23). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A self-contained instrument for the determination of bone mineral content by photon absorptometry is described. A high-resolution detection system allows measurements to be made at up to 16 photon energies. Control and arithmetic functions are performed by a microprocessor. Analysis capability and limitations are discussed. (auth)

9331 (AEC-tr—7315, pp 56-61) **Experimental investigations on the probability distribution of the output signal of the integrator.** Kreindlin, I.I.; Savitsku, L.G.; Skoblo, Yu.A. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

Radioisotope relay equipments (RRE) have received wide application in the different branches of the national economy. However, in the majority of cases, radioactive sources of exaggerated activity are used due to the absence of systematic investigations on the statistical character of disintegration of the radioactive sources. Besides, some fine but feasible problems remain unsolved for the same reason. The results of the experimental investigations on the distribution of the output signal of integrator are presented. The following was determined in the experiments: the probability density function of the output signal of the integrator, the number of overshootings of the output signal for the given level, and the average time interval (To) between the false responses at To much greater than tau (tau is the time constant of the integrator). (auth)

9332 (AEC-tr—7315, pp 61-70) **Data unit of a β-thickness guage of coatings.** Pravikov, A.A. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The amount of registered back scattered electrons in the irradiation of controlled articles with a β-particle beam depends substantially on the dimensions of the elements of the data unit. The least systematic error of measurement of thicknesses of coatings on small surface areas due to change of the distance between the detector and the controlled article can be obtained in the case of absence of rigid fixation of the value of the controlled surface. Considerations applied to this case are given for the choice of the distance between the detector and the controlled article, the depth of the collimator, and the diameter of the collimating orifice. The required activity of the β-radiation source is calculated. Requirements are presented for the specific activity of the source as a function of the surface of control. Finally, a data-unit prototype is described, which enables measurements on a surface of 10 mm². (auth)

9333 (AEC-tr—7315, pp 70-75) **Some characteristics of the radioisotope absorption method for the measurement of gas pressures.** Mashinin, V.A.; Pelenitsyn, N.N.; Rogozhin, O.V. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

Quick-response methods of measuring gas pressures are necessary for the solution of many research and technical problems. The possibility for the creation of a quick-acting radioisotope manometer, based on the absorption and scattering of α-particles by a gaseous medium, is investigated. (WHK)

9334 (AEC-tr—7315, pp 100-108) **Effect of instrumental instabilities on the exploitation parameters of radio-isotope relay equipment.** Kreindlin, I.I. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The determination of the exploitation characteristics and potentialities of radioisotope relay equipment (RRE), as applied to the solution of concrete problems, as a function of the instrumental and electrical parameters of the equipment, is one of the important questions. Expressions have been obtained which relate the exploitation statistical reliability in the conditions of operation and slackening T_1 and To, the quick action t_{01} and t_{10}, the value of the drop 'K', the required counting velocity n_1 and n_0, and consequently the activity of the radiation source, with the time constant of the detector 'tau' the effectiveness of the detector, and the necessary established threshold values of the apparatus n_{01} and n_{10}. The relations between the different parameters were obtained without the consideration of the possible instabilities of the following basic sub-assemblies of the RRE: detector, amplifier, pulse shaper, integrator and threshold cascade. These instabilities are expressed as the change of the calculated established threshold quantities n_{01} and n_{10} by some values Δn_{01} and Δn_{10} respectively. (auth)

9335 (AEC-tr—7315, pp 196-201) **Radioisotope scintillation level gauge: regulator RSUR-1.** Kreindlin, I.I.; Kolyada, A.N.; Pakhynkov, Yu.I. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The radioisotope scintillation level gauge-regulator RSUR-1, intended for continuous remote measurement of the level of liquids (for example, nitric acid in an autoclave) and the admission of a control signal in the system of automatic control is described. The apparatus consists of the γ radiation source block BIIP-1 and the scintillation detector GDS-1 which are stationed on the opposite sides of the reservoir, the electronic block, and the electronic automatic self-recording potentiometer EPP-09M3-3 which has a pneumatic isodromic regulating mechanism. (WHK)

9336 (AEC-tr—7315, pp 201-207) **Universal radioisotope relay apparatus RTR-1.** Kreindlin, I.I.; Skoblo, Yu.A.; Khakhalin, V.V. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The functional circuit and the construction of the universal radioisotope relay apparatus RTR-1 are given. (WHK)

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

REFER ALSO TO CITATION(S) 9226

9337 (PEM—30) **Nuclear EMP: bulk current in an insulated cable lying on the surface of the earth.** Brown, G.L. (Resource Engineering and Planning, Huntsville, Ala. (USA)). Feb 1975. 18p. Dep. NTIS $4.50.

This note is concerned with the problem of predicting the bulk current that will be generated in an insulated cable, lying on the surface of the earth, by an EMP field. The point of departure for developing a solution to the problem is a set of differential equations developed by E. D. Sunde. The work done by Putzer, Brown and Schwartz in obtaining a solution for the currents in the terminal loads of such a cable is summarized. This note also presents the derivation of some simplified equations for estimating the maximum current that could be generated in a surface cable by an EMP. Such an estimate is useful in determining how much EMP protection to apply. The derivation consists of making a series of approximations and assumptions. A comparison is made of predicted maximum values of bulk current and the cur

9338 (PEM—33) **Nuclear EMP: voltage clamping levels for several TransZorb transient suppression devices.** Clark, O.M. (General Semiconductor Industries, Inc., Tempe, Ariz. (USA)). Mar 1975. 8p. Dep. NTIS $4.50.

Voltage clamping levels for the 1N5629A, 1N5545A, 1N5654A, and 1N5664A TransZorb/sup T.M./ silicon transient-suppression devices in a DO-13 package are presented as data in photographs of test waveforms. A graph is compiled which illustrates the clamping voltage at a time point of 80 nsec for each of the devices. The duration of the test pulse was 250 nsec with a slope of 4 kV per nsec for the rise portion. Clamping levels are nearly constant for test current amplitudes of up to 120 A. (auth)

9339 (PEM—34) **Nuclear EMP: transient current estimates for finite length surface cables.** Wilson, M.R. (Mission Research Corp., Albuquerque, N. Mex. (USA)). Feb 1975. 30p. Dep. NTIS $5.00.

A finite length insulated wire lying at the earth-air interface is modeled using a transmission line approach. Transient response to a double exponential incident pulse with 10 ns rise time is obtained for various incident polarizations, cable lengths, soil conductivities and termination impedances. Characterizing all cases, the induced current pulses peak at approximately (3 to 20) amps/kv with rise time approximately (.1 to .2) μsec. A simple bare wire surface cable model current estimate is shown to be in good agreement with results from a more sophisticated model of a wire near the ground plane. (auth)

9340 (PEM—38) **Nuclear EMP: key suppression device parameters for EMP hardening.** Durgin, D.L.; Brown, R.M. (Braddock, Dunn and McDonald, Inc., Albuquerque, N. Mex. (USA)). Mar 1975. 20p. Dep. NTIS $4.50.

The electrical transients induced by EMP exhibit unique characteristics which differ considerably from transients associated with other phenomena such as lightning, switching, and circuit malfunctions. The suppression techniques developed to handle more common transients, though not necessarily the same devices, can be used for EMP damage protection. The suppression devices used for circuit level EMP protection are referred to as Terminal Protection Devices (TPD). Little detailed data describing the response of TPD's to EMP-related transients have been published. While most vendors publish specifications for TPD performance, there is little standardization of parameters and TPD response

models are not available. This lack of parameter standardization has resulted in a proliferation of test data that is sometimes conflicting and often not directly comparable. This paper derives and/or defines a consistent set of parameters based on EMP circuit hardening requirements and on measurable component parameters and is concerned only with use of TPD's to prevent permanent damage. Three sets of parameters pertaining to pertinent TPD functional characteristics were defined as follows: standby parameters, protection parameters, and failure parameters. These parameters are used to evaluate a representative sample of TPD's and the results are presented in matrix form to facilitate the selection of devices for specific hardening problems. (auth)

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 8392, 8579, 8642, 8654, 8702, 9101, 9206, 9370, 9414, 9492

9341 (AAEC/E—363) **Calibration of a JSEM-200 electron microscope.** Blake, R.G.; Jostsons, A.; Kelly, P.M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1975. 27p. Dep. NTIS (US Sales Only) $4.00.

The results of a detailed calibration of a JSEM-200 scanning transmission electron microscope are reported. Two types of measurements have been made: (a) calibration of the various parameters associated with scanning transmission (STEM) imaging, and (b) calibration of the usual parameters required for analytical diffraction contrast experiments in the conventional transmission mode (CTEM). The report also contains a detailed discussion of the various STEM imaging modes and the microscope settings necessary to obtain the required image. (auth)

9342 (BNL—20813) **Simple SEM to dark field STEM conversion stub.** McKinney, W.R.; Hough, P.V.C. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 3p. (CONF-760406—1). Dep. NTIS $3.50.

From 9. annual scanning electron microscopy symposium; Toronto, Canada (6 Apr 1976).

This paper describes a modified specimen stub which easily converts a standard SEM to the dark field scanning transmission mode. A conventional EM specimen grid is suspended transverse to the beam approximately 15 mm above a standard SEM stub. The unscattered and inelastically scattered components of the transmitted beam strike a diametral stripe of colloidal carbon on the stub, and are effectively discarded. The elastically scattered component, scattered at greater angles, strikes gold foil which covers the remaining parts of the stub. Secondary electrons from the gold are collected by the standard SEM detector. The detector signal is then a dark field STEM signal which is correlated with the scattering power of the specimen. A micrograph of unstained, unshadowed T4 bacteriophage taken with the dark field stub and an AMR 1000 SEM is presented. (auth)

9343 (CEA-CONF—3079) **Very low temperature precision microcalorimetry.** Claudet, G.; Gravil, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). 1975. 6p. (In French). INIS.

From Meeting on calorimetry and thermal analysis; Grenoble, France (22 May 1975).

To measure a very low-level heat flux, about one microwatt, with maximum precision, it was decided to make use of the possibilities offered in the temperature range of a few degrees Kelvin using liquid helium. The method described is reserved for applications where the heat source can be cooled to about 2°K without trouble, which is the case for nuclear radiation measurements. (FR)

9344 (CEA-R—4713) **Automatic shape recognition of a fast transient signal.** Charles, G. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jan 1976. 137p. (In French). Dep. NTIS (US Sales Only) $6.00.

Thesis. Submitted to Paris Univ.

We have developed a system to recognize if the shape of a signal x(t) is similar (or identical) to the one of an element y/sub i/(t) of an ensemble S composed by N known signals that are memorized. x(t) is a time limited (T less than or equal to 1 μs)-band limited (F/sub M/ less than or equal to 100 MHz) single shot signal. The amplitude of its maximum is unknown and can vary in a ratio of 100. The processing (shape—recognition) is made on a minicomputer. The calculus of the square of the correlation-coefficient (rho^2) gives the similarity measure of two signals. To solve the problem of the digital recording of the signals x(t) we have realized two devices: a digital-to-analog converter which permits the recording of fast transient signals (band pass greater than 1 GHz, sampling-frequency approximately 100 GHz, resolution: 9 bits, 576 samples); an automatic attenuator which scales the signal x(t) before the digitalization (the band pass is 70 MHz at -1 dB). A theoretical analysis permits to determine what must be the resolution of the digital-to-analog converter as a function of the signal-characteristics and of the wanted precision for the calculus of rho^2. (auth)

9345 (CONF-741040—P2, pp 125-135) **Development of scanning proton microscopy.** Escovitz, W.H.; Fox, T.R.; Levi-Setti, R. (Univ. of Chicago, IL). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Vol. II.

An analysis of the factors which determine the attainable resolution in a scanning transmission ion microscope (STIM) indicates that the specific brightness of the ion source provides the main limitation. Calculations show that resolution in the 5 to 10 A region can only be attained with a source of specific brightness in excess of $\sim 10^4$ protons $sec^{-1} \cdot A^{-2} \cdot sr^{-1} \cdot V^{-1}$. A field ionization source, incorporated in a 65 keV scanning gun-microscope, was found to meet this demand. In this prototype, low resolution STIM, hydrogen ions are accelerated and focused by a two-electrode electrostatic lens. The beam, consisting of H^+ and H_2^+ ions, is made to scan the specimen and the transmitted ions are detected by a continuous-dynode electron multiplier. Proton microradiographs of biological specimens by critical range absorption have been obtained at a resolution of $\sim$ 2000 A. A magnetic spectrometer, presently under construction, will separate the charged and neutral components of the transmitted beam. Plans exist to reach high resolution by adding to the prototype gun-microscope an objective lens. An analysis of the damage to biological material caused by proton bombardment indicates that the damage should not exceed greatly that caused by an electron probe for comparable amounts of information obtained.

9346 (CONF-741040—P2, pp 154-165) **Use of the ion microprobe in industry.** Phillips, B.F. (Battelle Columbus Labs., Ohio). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Vol. II.

During the past 15 years as small research accelerators have been developed, a concurrent development of both small beam diameter ion guns and ion optics has resulted in a variety of instruments being produced which consist of an ion sputtering source and a secondary ion mass spectrometer. After a short historical review of these developments, the most common types of modern instruments will be discussed along with applications of them to various research and industrial problems. In general the ion probe has had its greatest application in the semiconductor and metallurgical industries because of its extremely high sensitivity and ability to profile elements as a function of both surface distribution and depth concentration. Typical problems include analysis of concentration variations in thin metallic or insulator films, implantation and diffusion profiles in semiconductors, and elemental association and concentration profiles in nuclear reactor tubes.

9347 (CRN-CNPA—75-2) **Temporal response and real time measurements with 5GHz photocell-oscilloscope system at low light levels.** Sipp, B.; Miehe, J.A.; Clement, G. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1975. 20p. INIS.

Experiments were carried out to investigate by means of picosecond mode-locked laser pulses the performance of fast vacuum photoelectric cells associated with a high sensitivity and high speed cathode-ray tube provided with a channel plate electron multiplier. With an amplitude sensitivity of 140 mV/cm an overall time of response of less than 100 ps was measured. (FR)

9348 (CRN-CNPA—75-11) **Time-of-flight mass spectrometers with particle guide.** Igersheim, R.; Abbe, J.Ch.; Paulus, J.M. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). 1973. 19p. (In French). Dep. NTIS (US Sales Only) $4.50.

Two time of flight mass spectrometers have been designed. The first one consists of an arrangement of a pulsed ion source, an electrostatic particle guide and a detector; an ion reflector was added in the second aparatus. The supply of a particle guide appears to be particularly efficient in the second case for the analysis of low energy beams. The higher the initial kinetic energy of the ions, the more important is the corresponding increase in sensitivity. (auth)

9349 (IFTJ—69/E) **WANG 700 minicomputer interface type 700/H.** Wolski, K. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1975. 14p. (In Polish). Dep. NTIS (US Sales Only) $3.50.

The Interface 700/H described is designed especially for data transfer from the multichannel pulse-height analyzer of the Hungarian NTA family, as well as from the punched paper tape reader "READMOM", to the WANG minicomputers of the series 700. The principle of operation of the interface and basic technical parameters of the interfaced devices are presented. (auth)

9350 (LA-UR—75-2312) **Status report on electronic identification.** Holm, D.M.; Bobbett, R.E.; Koelle, A.R.; Landt, J.A.; Sanders, W.M.; Depp, S.W.; Hensley, J.C. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 11p. (CONF-751161—1). Dep. NTIS $3.50.

From Annual meeting of the U. S. Animal Health Association; Portland, Oregon, United States of America "USA" (3 Nov 1975).

A significant milestone was passed in September 1975, with the successful operation of a subdermally-implanted, temperature-indicating transponder having hybrid circuitry. This transponder had no batteries and showed that an implant transponder could be powered by an external microwave beam and transmit encoded temperature information back to the receiver. The encoding of temperature was done because it was very similar to identification, but required much less circuitry. The microwave power levels at the animal skin were well within established safety limits. Additional work needs to be performed on optimizing circuitry and antenna design. (auth)

9351 (LMEC-TDR—75-6) **High-temperature strain gage evaluation: Ailtech (Microdot) Models SG-420 and SG-425.** Twa, G.J. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 15 Sep 1975. Contract E(04-3)-700. 334p. AT.

This report describes the development of installation and calibration techniques necessary for use of the Ailtech (Microdot) Series 400 weldable strain gages. This work was performed between late 1968 and mid 1970. Techniques were developed for installation of the strain gage and removal from the calibration bar in the laboratory, which allowed reliable precalibration of the strain gage prior to installation. Evaluation of the Ailtech Models SG-420 and SG-425 strain gages was conducted over the temperature range of room temperature to 900°F. Stabilization techniques were developed to improve the change in gage characteristics with time. Response of these gages under thermal transients was investigated. Sodium proof tests of two SG-425 gages were conducted from October 1974 through March 1975 with no indication of sodium penetration. (auth)

9352 (UCRL—13670) **High "G" calibration of accelerometers.** Brown, G.W. (California Univ., Berkeley (USA). Coll. of Engineering). Oct 1975. 21p. Dep. NTIS $3.50.

The relation between the strain in an elastic wave traveling along a slender rod and the acceleration of a free end as the wave reflects from that end is given by the equation $\epsilon = 1/(2c)$integral adt, where a = acceleration, c = wave velocity, and ϵ = strain in the rod. An air gun and projectiles have been built to induce the strain wave in the rod. The system was designed to achieve accelerations of 100,000 g's and pulse lengths of from 50 to 150 micro-seconds. An instrument has been built to compare the peak values of the strain as recorded by a foil strain gage and the integral of the acceleration as recorded by an accelerometer fastened to the free end of the rod. The instrument is designed in such a way that the calibration constant of the accelerometer is displayed immediately on a digital voltmeter. Also, in conjunction with a time interval counter, the instrument measures the wave velocity, c. (auth)

9353 (USGS—474-214) **New permanent-installation device for monitoring stress changes in NX core holes.** Miller, C.H.; Kibler, J.D.; Ege, J.R. (Geological Survey, Denver, Colo. (USA)). Sep 1975. 60p. Dep. NTIS $5.45.

A solid-inclusion probe has been developed to monitor stress changes in rock. The probe is designed for use in NX-sized drill holes and it can detect stress changes from 0 to 5,000 pounds per square inch from a few milliseconds to a few years in the time domain. These probes have been used to monitor the dynamic stresses of low-yield nuclear detonations at a distance of a few hundred feet and they have remained operable during and after the detonations. The device is composed of fluid-filled hydraulic cells that are mounted radially on a mandrel. The device is emplaced and grouted in a newly drilled NX hole. Stress changes in the wall rock result in borehole diameter changes that vary the hydraulic-cell pressure. Relative cell pressures can be monitored by either Bourdon gages or electronic transducers. Hydraulic-cell pressure changes are used to calculate rock-stress change. (WHK)

9354 **LLL streak camera (15 Aug 1974) (Engineering Materials).** (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE—524(Rev.)).

11 drawings.

9355 **Preamplifier: charge or current sensitive, direct coupled, for general purpose counting (4 Jun 1975) (Engineering Materials).** (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE—2412).

5 drawings.

9356 (ERDA-tr—105) **Mini-Dialyser FA-11.** Kokumai, Y. 1975. Translation of Japanese report. 17p. Dep. NTIS $3.50.

The Mini-Dialyser FA-11 is an extremely small disposable type dialysis unit and a has a priming volume amounting to only 50 ml. The unit as received has been completely sterilized using E. O. gas, thereby permitting labor savings in that the unit is ready for use. The unit may be used in conjunction with any presently existing Kiil hemodialyser feed equipment, and it normally does not require the use of a blood pump because of its low internal resistance. The performance of the unit is 40 percent or more better than that of the standard flat plate type Kiil apparatus, and it is equivalent to that of the coil type, so that it is possible to shorten the time required for dialysis. The handling of the equipment is simple, which also makes it suitable for use at home. Specifications, characteristics and performance, and instructions for use are presented. (WHK)

9357 **Digital image processing.** Hunt, B.R. (Los Alamos Scientific Lab., NM). *Proc. IEEE (Inst. Electr. Electron. Eng.);* **63**: No. 4, 693-708(Apr 1975).

A review of the field of digital image processing is presented, with concentration upon image formation and recording processes, digital sampling and digital image display, and with in-depth coverage of image coding and image restoration. New results in image restoration are also presented, covering restoration by use of an eye-model constraint and nonlinear restoration by maximization of the posterior density function. 98 references (auth)

9358 **Pole-zero cancellation in the feedback circuit of wide-band preamplifiers to improve the baseline stability for high count rates or large signals.** Kopp, M.K. (Oak Ridge National Lab., TN). *Rev. Sci. Instrum.;* **46**: No. 8, 1120-1121(Aug 1975).

Pole-zero cancellation was applied to the feedback circuit of wide-band preamplifiers to improve the baseline stability and reduce the saturation of the output for high count rates (10^6 counts/sec) or large output signals (>1 V), without compromising the bias point stabilization.

9359 **Development of a multipurpose optical system for use with a centrifugal fast analyzer.** Burtis, C.A.; Bostick, W.D.; Johnson, W.F. (Oak Ridge National Lab., TN). *Clin. Chem.;* **21**: No. 9, 1225-1233(Aug 1975).

From 7. annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975).

See CONF-750319—.

A Centrifugal Fast Analyzer is basically a sophisticated photometric measuring device containing a multicuvet rotor as its major component. Several reactions are simultaneously initiated in the rotor, which is then rotated through a stationary optical monitor and the resulting signals acquired and processed by an on-line data system. With the miniature version of this analyzer, one has the option of directing the incident optical beam, via a fiber optical bundle, into the cuvets of the spinning rotor in either a 90° or a 180° orientation relative to the analyzer's photodetector. The combination of newly designed rotors and a flexible optical system having multiple configurations has provided a versatile system in which one can measure the transmittance, fluorescence, chemiluminescence, or light-scattering (either turbidimetrically or nephelometrically) properties of the ensuing reaction species, all with a single analyzer. This flexibility in choosing the optical mode in which a particular set of reactions is to be monitored provides the analyst with a powerful and versatile analytical tool for developing new methods for use in various clinical laboratory applications, including chemistry, toxicology, immunology, and hematology. (auth)

9360 **Flow-system multiangle light-scattering instrument for cell characterization.** Salzman, G.C.; Crowell, J.M.; Goad, C.A.; Hansen, K.M.; Hiebert, R.D.; LaBauve, P.M.; Martin, J.C.; Ingram, M.L.; Mullaney, P.F. (Los Alamos Scientific Lab., NM). *Clin. Chem.;* **21**: No. 9, 1297-1304(Aug 1975).

From 7. annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975).

See CONF-750319—.

A flow-system cell-analysis instrument is described in which cells from a heterogeneous population are characterized by their light-scatter patterns alone. As the cells pass at high speed through a focused helium/neon laser beam, the scatter pattern from each cell is sampled simultaneously at up to 32 angles between 0° and 30° with respect to the laser beam axis, and the scatter pattern for each cell is transferred to a computer. A mathematical clustering algorithm is used to determine the number of classes into which the cells can be divided, and a linear separation algorithm is used to find the boundaries between the classe. Preliminary results on exfoliated cells from gynecological specimens are presented. This technique may be useful for automated prescreening of gynecological specimens. (auth)

9361 (ERDA-tr—96) **Fundamentals of thermometry.** Gerashchenko, O.A. Dec 1975. Translation by W.J. Grimes of Osnovy teplometrii, "Naukova Dumka" Press, 1971. 223p. Dep. NTIS $7.75.

Basic information on the theory, design, and use of instruments for measuring heat flux over a wide range of densities and temperatures is given. Topics include: methods of measuring heat flux; individual heat flux sensors; multiple sensors; calibration measurements of radiant flux at low and moderate temperatures (+-200°C); calibration measurements of conductive fluxes at low and medium temperatures (+-200°C); calibration at high temperatures (up to 600°C); and derivative instruments and several cases of the use of thermometry in scientific research. (WHK)

9362 **Optimization of eddy current measurements of coil-to-conductor spacing.** Smith, J.H.; Dodd, C.V. (Oak Ridge National Lab., Tenn.). *Mater. Eval.*; **33**: No. 12, 279-292(Dec 1975).

A detailed analysis of the problem of measurement of coil-to-conductor spacing (lift-off) is performed. Flat, pancake-shaped coils have the greatest sensitivity to lift-off, although a compromise must be made between coil thickness and dc resistive drift. For any given value of nominal lift-off, there is an optimum value of coil size for maximum sensitivity. Other variables such as operating frequency and thickness of the conductor are also considered. (auth)

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 8291, 8292, 9091

9363 (MHSMP—75-40I) **HNS recovery from DMF recrystallization filtrate. Progress report, July—September 1975.** Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Sep 1975. Contract DA-11-173-AMC-487. 11p. Dep. NTIS $3.50.

A recrystallization process was developed and documented, whereby 2,2′, 4,4′, 6,6′-hexanitrostilbene (HNS), with an approximate bulk density of 0.5 g/cc, can be reproducibly obtained from solution in N,N-dimethyl formamide (DMF). During the process, however, a portion of the solute is tenaciously retained by the filtrate. The high-cost of HNS warrants its extraction; consequently a low-cost recovery method was pursued. Low-cost recovery of HNS, retained by the filtrate during the recrystallization process, can be promoted by dilution of the mother liquor with a water-methanol solution.

9364 (MHSMP—75-40K) **Initiation sensitivity of HNS I by HNS II MDF. Progress report, July—September 1975.** Hanes, L.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Sep 1975. Contract DA-11-173-AMC-487. 10p. Dep. NTIS $3.50.

A sensitivity test previously developed to study the configuration dependent excess transit time for transfer of detonation from a small diameter confined donor to a larger diameter unconfined acceptor via the detonation electric effect technique has been utilized for evaluation of Pantex synthesized HNS.

9365 (MHSMP—75-40N) **Slow PBX and plant wave lens development. Progress report, July—September 1975.** Crutchmer, J.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1975. Contract DA-11-173-AMC-487. 13p. Dep. NTIS $3.50.

Work has been completed on three each pressable plane wave lens designs. One of these, of the P/040 configuration using pressable Comp B-3 and 76/24 BN/TNT baratol, was completed and reported some time ago. Results of this lens are being reported here for completeness of this report. Work was recently completed on a P/081 lens design using these same materials. A higher index lens of the P/040 configuration was also recently finalized. This lens design uses PBX 9404 as the fast component and 85/15 BN/TNT baratol as the slow component. (auth)

9366 (SAND—75-0516) **Light-initiated explosive for impulse experiments on structural members.** Benham, R.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 18p. Dep. NTIS $4.50.

An experimental technique utilizing spray-deposited light-sensitive high explosive has been developed for the purpose of delivering impulse loads to mechanical structures. An intense flash of light causes the explosive to detonate, producing a nearly simultaneous, distributed impulse load on the sprayed structure. Simple structures as well as complex systems requiring contoured and/or discontinuous loading can be tested. This paper describes the experimental technique and discusses the data obtained from a test on an elastic beam. The experimental data are compared to elastic theory predictions. The good agreement between experiment and theory verifies that this technique can be used satisfactorily for studying the response of structures to impulse loading in the laboratory. (auth)

9367 (UCRL-Trans—10778) **Energy transfers in explosive propulsion.** Defourneaux, M. Translated from *Sci. Tech. Armement*; **47**: No. 3, 723-930(1973). 239p. Dep. NTIS $8.00.

The use of high explosives as sources of kinetic energy for the propulsion of inert masses is examined and compared with powders and propellants for propulsion purposes. (TFD)

9368 (SAND—76-6014) **Transition of combustion of condensed systems to detonation: development of burning in a single pore.** Belyaev, A.F.; Bobolev, V.K.; Korotkhov, A.I.; Sulimov, A.A.; Chuiko, S.V. Feb 1976. Translated by P. Newman from pp 115-134 of Transition of combustion of condensed systems to detonation, Chapter 5, Part A, Section 22. 39p. Dep. NTIS $4.00.

The ignition and combustion of the channel of a powder charge in a rocket motor were examined. Experiments conducted clarified the role of combustion in crack development. It was established that, in the initial stage, combustion makes crack growth possible, since combustion penetrates rapidly into pores forming at the end part of the crack. In the final stage, combustion may exert a stabilizing effect, which is associated with the burning up of the tip of the crack-the stress concentrator. (TFD)

NUCLEAR

REFER ALSO TO CITATION(S) 9353, 9397, 9418, 9419

CIVIL USES

9369 **Approximate spherical blast theory including source mass.** Freiwald, D.A.; Axford, R.A. (Los Alamos Scientific Lab., NM). *J. Appl. Phys.*; **46**: No. 3, 1171-1174(Mar 1975).

Equations including source mass are presented for strong spherical blasts in cases where the source mass is not negligible. Analytic solutions are obtained for shock speed, position, and overpressure as a function of radius. Approximations similar to those used in the Taylor—Sedov approximate theory are employed. Shock positions as functions of time are obtained via evaluation of incomplete elliptic integrals. Sample calculations are presented for a laser-initiated 1-MJ (debris energy) pellet microexplosion, and compared to Taylor—Sedov approximate theory solutions. 3 figures (auth)

WEAPONRY

REFER ALSO TO CITATION(S) 9277

EXPLOSION DETECTION

9370 (UCID—17015) **Nads FSK Modem, LEA 74-2248.** Johnson, K.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jan 1976. Contract W-7405-Eng-48. 29p. Dep. NTIS $4.00.

The Nads FSK Modem is a compact unit designed to operate in conjunction with EIA standard interfacing and the data terminal equipment of the 1200 Baud digital communications network of the Nevada Automated Diagnostics System (NADS). The modem is constructed in a Nuclear Instrumentation Module

System (NIMS) module for compatability with the NADS system. The modulator section of the modem accepts serial, digital signals at 1200 Baud which may be either standard TTL levels or bipolar signals meeting either the EIA RS-232C or RS-232B standards. The output of the modulator is a Frequency-Shift Keyed (FSK) signal having frequencies of 2.2 kHz for Mark and 1.2 kHz for Space. The demodulator section accepts the above FSK signal as input, and outputs serial, digital signals at 1200 Baud at either TTL or EIA RS-232C levels. Specifications and operation and calibration instructions are given. (WHK)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 8810, 8811, 8812, 8815

9371 (CEA-R—4681) **Study of photolytic aerosols at stratospheric pressures.** Delattre, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection; Paris-6 Univ., 75 (France)). Jul 1975. 82p. (In French). INIS.

An experimental study of photolytic aerosol formation at stratospheric pressure (60 Torr) and laboratory temperature, was carried out previous to the exact simulation of photolytic aerosol formation in real stratospheric conditions. An experimental simulation device, techniques of generation of known mixtures of inert gases with SO_2 and NO/sub x/ traces at low concentration (below 1 ppM volume) and H_2O traces (a few ppM), and techniques for the determination and counting of aerosol particles at low pressures were perfected. No photolytic aerosol production was ascertained at 60 Torr when water concentration was below 100 ppM whatever the concentration of SO_2 or NO/sub x/ traces. With water concentration below 1200 ppM and SO_2 trace concentration below 1 ppM, the aerosol particles produced could not consist of sulfuric acid drops but probably of nitrosyl sulfate acide crystals. (FR)

9372 (CONF-760311—4) **Characterization of solid specimens from environmental pollution studies using electron x-ray and nuclear physics methods.** Hulett, L.D.; Dunn, H.W.; Dale, J.M.; Emery, J.F.; Lyon, W.S.; Murty, P.S. (Oak Ridge National Lab., Tenn. (USA)). 1976. 7p. Dep. NTIS $3.50.

From Symposium on the development of nuclear-based techniques; Vienna, Austria (15 Mar 1976).

This paper illustrates how the properties of environmental particulate matter can be better understood if a multitechnique examination is conducted. Some results for fly ash, using neutron activation analysis, scanning electron microscopy, photoelectron spectroscopy (ESCA), x-ray fluorescence and x-ray diffraction are described. The difference in composition between the surfaces and interiors of particles are discussed and the effects of water leaching on surface composition are shown. The propensity of natural iron oxide substrates to cover themselves with adsorbed material is illustrated; this may be an important factor in the transfer of pollutants on particulate matter surfaces. The final section describes how the element detection sensitivity can be predicted for an improved x-ray fluorescence system that uses monochromatic AgKα radiation for excitation.

9373 (ERDA—110(Vol.5)) **Federal inventory of energy-related biomedical and environmental research for FY 1974 and FY 1975. Volume V.** (Energy Research and Development Administration, Washington, D.C. (USA)). 1975. 397p. Dep. NTIS $10.60.

Biomedical and environmental research projects are outlined under the following headings: characterization, measurement, and monitoring; environmental transport processes; ecological effects; air/terrestrial; ecological effects; freshwater; and integrated assessment. Data are given for the following federal agencies: National Science Foundation, Department of Commerce, Department of the Interior, Department of Agriculture, and Department of Defense. The following divisions of the Department of Commerce are considered: National Oceanic and Atmospheric Administration, National Bureau of Standards, and Office of Environmental Affairs. The following divisions of the Department of the Interior are considered: Fish and Wildlife Service, U.S. Geological Survey, Bureau of Land Management, Bureau of Mines, and Bureau of Reclamation. (HLW)

9374 (PRNC—192(Vol.1)) **Winds for Puerto Rico with summaries, Ponce 1971—1974.** Wood, E.D. (Puerto Rico Nuclear Center, Mayaguez). 1975. Contract E(40-1)-1833. 159p. Dep. NTIS $6.75.

Wind data obtained from the Ponce airport tower for the period January 1, 1971 to December 31, 1974 are presented. The data contain direction to the nearest 10° for the direction the wind is blowing from, and velocity in knots. The data were taken hourly 15 minutes before the hour for 16 hours per day from 0645 to 2045. An overview of the data shows that the wind rises in the NE in the morning, shifts to SE by noon, and returns to NE in the evening. The highest velocities are from the SE. The wind rarely blows from the directions 180° to 360°. The computer print-out included contains the program listing plus the raw data, monthly averages and summaries for the years 1971, 1972, 1973 and 1974. The wind was also tabulated by velocity frequency. (auth)

9375 (UCRL—51943) **San Francisco Bay and Delta system: a selected bibliography.** Buchanan, M.F.; Ritschard, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. Contract W-7405-Eng-48. 496p. Dep. NTIS $10.60.

A selected bibliography of over 2500 references describing the prevailing conditions of the San Francisco Bay and the Sacramento-San Joaquin Delta system is detailed. Seven major categories—Environmental Studies, Physical Sciences, Aquatic Studies, Effects, Waste Management, Water, and Related Resources and Legal Studies, are further divided into twelve subject heaings with extensive cross-referencing. Geographical designations are: Sacramento-San Joaquin River and Delta System; San Francisco Bay; and San Francisco Bay Area. Each major category is preceded by a section of general related references. (auth)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 8249, 9113, 9541, 9716

9376 (CONF-750681—1) **Instrumental practice in the CVS method of exhaust emission measurement.** Hurn, R.W. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). 1975. 10p. Dep. NTIS $4.00.

From Fuels and lubricants meeting; Houston, Texas, USA (3 Jun 1975).

The SAE paper is intended to describe, and to a limited extent review, a more comprehensive document on instrumental practice. The parent document was prepared for the Coordinating Research Council for use as a reference guide to good practice in selection and use of instruments for measurement of auto emissions. The summary paper includes information regarding instrumental principles wherein such information is deemed helpful in understanding practical problems and sources of measurement error or variability. Other than for the brief review of instruments principles, the summary paper is devoted primarily to describing the context of the parent document in covering selection, calibration, and good operating practice of instruments used in the constant volume sampling method of exhaust emissions measurement. (auth)

9377 (EPA—600/5-74-009) **Cost-effectiveness of a uniform national sulfur emissions tax.** Bingham, T.J.; Cooley, P.C.; Fogel, M.E.; Johnston, D.R.; LeSourd, D.A.; Miedema, A.K.; Paddock, R.E.; Simons, M. Jr.; Wisler, M.M. (Environmental Protection Agency, Washington, D.C. (USA). Office of Research and Development). Feb 1974. 189p. GPO $2.25.

The following topics are discussed: the application of emissions taxes for pollution control; analysis of the effectiveness and costs of a tax on sulfur emissions; source-by-source analysis of the effectiveness and costs of a tax on sulfur emissions; and impact of sulfur tax on air quality in two hypothetical air quality control regions. (HLN)

9378 (NP—20836) **Mercury and the environment: studies of mercury use, emission, biological impact, and control.** (Organization for Economic Co-Operation and Development, 75 - Paris (France)). 1974. 196p. OECD Nuclear Energy Agency, Paris.

Unique properties of mercury and its compounds are discussed as well as production and international trade in mercury. Mercury in the environment is discussed with regard to concentrations, transformations, mercury ingestion by man, and acceptable daily intake. Other topics discussed are: technical alternatives for mercury use; comparison of methods for control of mercury use; and benefits of mercury to society. (HLW)

9379 (NP—20836(App.)) **Mercury and the environment: studies of mercury use, emission, biological impact, and control. Ap-**

pendices. (Organization for Economic Co-Operation and Development, 75 - Paris (France)). 18 Sep 1973. 44p. Dep. NTIS (US Sales Only) $4.00.

The following appendices to mercury and environment studies (NP-20836) are presented: industrial licensing categories specified under Swedish environmental protection law; regulations for the control of mercury in liquid effluents discharged by chloralkali plants; guides for provisional control measures against environmental pollution by mercury; costs for mercury reduction at Swedish chloralkali plants; an example of good practical mercury technology applied to a mercury cell chloralkali plant in Canada; comparative costs of mercury cell and diaphragm cell methods of caustic soda production in Japan; and report on treatment of waste streams containing mercury. (HLW)

9380 (NTIS/PS—75/209) **Mercury pollution. A bibliography with abstracts. Search period covered: 1964—October 1974.** Werner, K.G. (National Technical Information Service, Springfield, Va. (USA)). Feb 1975. 159p. NTIS $25.00.

Pollution control, environmental sampling and analysis, and air and water quality data for mercury are covered by this bibliography of 113 abstracts. Toxicity and pollution effects are excluded. See also the related Published Search, NTIS/PS-75/210, Biological Effects of Mercury Pollution. (NTIS)

9381 (NTIS/PS—75/267) **Lead pollution. A bibliography with abstracts. Search period covered: 1964—October 1974.** Werner, K.G. (National Technical Information Service, Springfield, Va. (USA)). Feb 1975. 217p. NTIS $25.00.

The bibliography contains 171 selected abstracts concerning air and water pollution by lead. Emission and effluent control technology, detection and analysis, and air and water quality data, and general studies on lead pollution are covered. Radioisotope studies are included. The effects of lead on plants, animals, and humans and toxicity information is not included. For related research, see NTIS/PS-75/268, Biological Effects of Lead Pollution. (NTIS)

9382 (ORNL-EIS—83) **NSF-RANN Trace Contaminants Program directory.** Wilkinson, B.K.; Smith, S.K. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 84p. Dep. NTIS $5.00.

Research programs in the USA on pollution of the environment by trace amounts of toxic elements are outlined. (CH)

9383 (ORNL-EIS—84) **NSF-RANN trace contaminants abstracts.** Copenhaver, E.D. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

Abstracts of 64 reports on the contamination of air, soil, and water by trace amounts of toxic elements are presented. Abstracts of papers that describe measuring methods are also included. (CH)

9384 (ORNL-NSF-EATC—22) **Ecology and analysis of trace contaminants. Progress report, October 1974—December 1975.** Van Hook, R.I.; Shults, W.D. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 200p. Dep. NTIS $8.75.

A major effort in the ORNL Ecology and Analysis of Trace Contaminants program has been concerned with the development of a Unified Transport Model (UTM) which can be used to describe and predict the transport and fate of trace contaminants through the atmospheric, terrestrial, and aquatic environments. In concept the air, land, and aquatic systems are represented by three major model components, designed to be run in sequence. A suite of compatible submodels that can be assembled into a UTM to meet specific user requirements, (i.e., to meet researcher needs or management needs), was developed. This research has required evaluation and modification of existing models, development of new models, and application of the UTM and/or its components. (auth)

9385 (RISO-M—1813) **Aircraft measurements of air pollution over Denmark and the North Sea.** Heidam, N.Z. (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec 1975. 29p. Dep. NTIS (US Sales Only) $4.00.

Airborne measurements of the concentrations of gaseous and particulate sulphur and of Aitken nuclei have been performed as part of an international project to assess the role of long range transport of air pollution in Europe. A description is given of the measuring equipment installed in the aircraft and some of the results are presented and discussed. A definite correlation has been found between the concentrations of sulphate and sulphur dioxide and moreover, that during different pollution episodes the relation between them is almost the same. It has also been found that the concentration of Aitken nuclei correlates well with the concentration of sulphur dioxide, but that the correlation with sulphate concentration is dubious. In quite remote areas, such as over the ocean, and in meteorological situations favorable to long range transport it has been found that pollution levels are comparable to those encountered in large cities. (auth)

9386 (UCD—472-122, pp 164) **Comparative assessment of risks from pollutants associated with energy production.** Azevedo, J.; Book, S.A. Jun 1975.

In Annual report, fiscal year 1975.

A literature search was conducted on biological effects of such air pollutants as carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide and particulates. Pertinent articles were selected and catalogued on data analysis cards for future retrieval. Data available will be analyzed by mathematical models in terms of dose-time-biological effect. (HLW)

9387 (UCRL—77267) **Generic survey of air quality simulation models.** Sauter, G.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Feb 1976. Contract W-7405-Eng-48. 6p. (CONF-760407—1). Dep. NTIS $3.50.

From Conference on environmental modeling and simulation; Cincinnati, Ohio, United States of America "USA" (20 Apr 1976).

This survey of the generic types of models which have been developed for numerical simulation of air quality compares and contrasts them on the basis of such criteria as the simplifying assumptions made in the solution of the general continuity equation, the problems to which each model type is applicable and not applicable, the requirements for input data, and computational speed.

9388 (UCRL—77273) **Development and implementation of user oriented air quality models.** Walton, J.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1976. Contract W-7405-Eng-48. 6p. (CONF-760407—2). Dep. NTIS $3.50.

From Conference on environmental modeling and simulation; Cincinnati, Ohio, United States of America "USA" (20 Apr 1976).

Implementation of the Air Quality Act and its amendments requires that decisions be made, at various levels of government, on many complex questions. in order to facilitate the work of decision- and policy-makers, readily useable air quality models must be developed. Such models can have quite different requirements and constraints than those developed primarily for research purposes. These needs will be identified and past experience will be drawn upon to illustrate how some of them have or have not been met.

9389 (UCRL-Trans—10967) **Mercury in plants.** Galoppini, C. Translated from *Agric. Ital. (Pisa)*; **29**: No. 1, 60-78(1974). 23p. Dep. NTIS $3.50.

Air pollution, whose highest levels are found near factories producing or utilizing mercury, and the uses of organomercury compounds as fungicides in agriculture are the main source of the spreading and the accumulation of mercury in plants. Researches on mercury metabolism have shown that plants, through formation of sulfur containing peptides, can neutralize the poisonous effect of mercury taken up through the leaves, both as metal vapours (Hg^0), or as inorganic (Hg^{2}+) and organic (R-Hg+) cations. (auth)

9390 **Three-dimensional dynamical-chemical model of atmospheric ozone.** Cunnold, D.; Alyea, F.; Phillips, N.; Prinn, R. (Massachusetts Inst. of Tech., Cambridge). *J. Atmos. Sci.*; **32**: No. 1, 170-194(Jan 1975).

A three-year integration of a global three-dimensional model including dynamics and simple photochemistry is used to predict ozone. Distributions of NO_x and odd hydrogen deduced by McConnell and McElroy are used to incorporate in a simple way the chemical effect of these species. Good agreement with observation is obtained for stratospheric motion patterns, meridional circulations, ozone density as a function of height and latitude, eddy transports of ozone, surface destruction of ozone, and correlations of ozone with other variables. The annual cycle of columnar ozone in high latitudes is present, but at a smaller amplitude than observed. Vertical transport of ozone downward from the main generation level at 30 km is accomplished primarily by small-scale eddy diffusion between 20 and 30 km and again near the ground; large-scale vertical transport dominates inbetween. The model predicts a secondary maximum in ozone mixing ratio at 45 km somewhat equatorward of the winter polar-night zone. This feature, recently observed from satellite measurements, is thought to be caused by the temperature-dependence of reaction rates in the Chapman scheme. The principal deficiency of the model is an underprediction of the spring ozone concentration in high latitudes in the lower stratosphere. (auth)

9391 **Stratospheric ozone destruction by aircraft-induced nitrogen oxides.** Alyea, F.N.; Cunnold, D.M.; Prinn, R.G.

(Massachusetts Inst. of Tech., Cambridge). *Science;* **188**: 117-121(11 Apr 1975).

The potential depletion of stratospheric ozone by supersonic transport has lead to the development of a model to assess possible atmospheric effects. It was concluded that continuous stratospheric injection of NO/sub x/ could result in 12 to 16 percent reduction in ozone and a concomitant increase in ultraviolet radiation flux. (JWP)

9392 **Reports: spectroscopic observation of acid sulfate in atmospheric particulate samples.** Cunningham, P.T.; Johnson, S.A. (Argonne National Lab., IL). *Science;* **191**: No. 4222, 77-79(9 Jan 1976).

Infrared spectra of time- and size-classified atmospheric particulate samples collected with an inertial impactor reveal the presence of acid sulfate in the submicrometer-sized fraction. Although the degree of acidity is highly variable with time, the acidic nature of the particles is observed at all times of the day and may persist for several days in urban areas. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 9303

9393 (PB—239191) **Summary of radioactivity released in effluents from nuclear power plants during 1973.** (USAEC Office of Operations Evaluation, Washington, D.C.). Jan 1975. 53p. (OOE-OS—003). NTIS $4.25.

Releases of radioactivity in airborne and liquid effluents and the number of shipments and activity of solid waste have been compiled from licensee reports for 1973. There were wide variations in radioactive releases due to differences in plant size, power level, fuel performance, and effluent treatment methods. Data covering specific isotopes of particular interest have been summarized. In all cases, releases of radioactivity were only small fractions of permissible limits set by applicable regulations or in technical specifications. (GRA)

9394 (PB—240405) **Detailed measurement of ^{131}I in air, vegetation, and milk around three operating reactor sites.** Weiss, B.H.; Voilleque, P.G.; Keller, J.H.; Phillips, C.R. (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Inspection and Enforcement). Mar 1975. 81p. (NUREG—75/021). NTIS $4.75.

A study at three nuclear reactor sites to determine ^{131}I concentrations in the air-grass-cow-milk links of the food chain, as these are related to releases from the nuclear power plants, was prepared. The ^{131}I gaseous effluent release rates were measured in terms of other chemical forms of iodine and compared with previous measurements. Concentrations in vegetation were not generally observable, while measured milk concentrations appeared directly related to rainfall. Maximum air-to-vegetation transfer velocities were calculated, and two vegetation-to-milk transfer parameters were determined. (GRA)

9395 (TID—25650-S1) **Selected bibliography of terrestrial freshwater, and marine radiation ecology.** Schultz, V.; Whicker, F.W. (Washington State Univ., Pullman (USA). Dept. of Zoology; Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 1975. 244p. Dep. NTIS $7.60.

An extensive bibliography is presented of publications related to field or laboratory studies of wild species of plants and animals with respect to radiation effects or metabolic studies involving radionuclides. The references are listed under the following headings: status and needs of radiation ecology; environmental radioactivity; radionuclide concentration; ionizing radiation effects; techniques utilizing radionuclides and ionizing radiation in ecology; measurement of ionizing radiation; peaceful uses of atomic energy; waste disposal; nuclear testing and ecological consequences of a nuclear war; glossaries, standards, and licensing procedures; reviews of radionuclides in the environment; and sources of information. (HLW)

9396 (UCD—472-122, pp 78-81) **Assay of radon and daughter products by gel-scintillation counting.** Parks, N.J.; Tsuboi, K.K. Jun 1975.

In Annual report, fiscal year 1975.

The distribution of radon between the supernatant gas and the two-phase gel in emulsion scintillant systems was experimentally measured. The calculated partition coefficient was found to be constant for various sample conditions in agreement with theoretical predictions. The maximum efficiency for detection of radon and decay products under routinely attainable conditions yields an amplification factor of 5.90 per disintegration of ^{226}Ra in unquenched samples assayed for that isotope. The method described appears to be applicable for efficient assay of other environmentally important radioactive noble gases such as ^{85}Kr. (auth)

9397 (UCRL—51625-75) **Progress in rainout research at Lawrence Livermore Laboratory: fiscal 1975.** Knox, J.B.; Molenkamp, C.R.; Harvey, T.F.; Peterson, K.R.; Barbieri, J.F.; Lange, R.; Fulk, M.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1975. Contract W-7405-Eng-48. 103p. Dep. NTIS $5.50.

The collateral damage that can result from the precipitation scavenging of nuclear aerosols produced by low-yield nuclear explosions was investigated. The status of the scientific understanding necessary to make estimates of rainout-produced radiation fields, the development of models and methodologies for rainout assessments, and attempts at removing uncertainties from these models and assessment results are discussed. (CH)

REGULATIONS

REFER ALSO TO CITATION(S) 8807

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 8811, 8813, 9120, 9373, 9375

9398 (AECL—5041/2) **Hydrological studies on a small basin on the Canadian shield. A final summary of the Perch Lake evaporation study, 1965—1974. Volume II.** Barry, P.J. (ed.). (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1975. 744p. Dep. NTIS (US Sales Only) $18.75. AECL $20.00 per set.

Data are summarized from a series of studies carried out in the Perch Lake basin between 1965 and 1974. Perch Lake is a small sub-basin of the Ottawa River on the property of the Chalk River Nuclear Laboratories about 200 km west northwest of Ottawa. The results of evaluations of techniques commonly used to estimate lake evaporation and ground water contributions to the lake water budget are included. Hydrological studies in the basin to develop better methods of estimating evaporation and ground water flow and for studying the transport and behavior of heavy metal cations in the surface and sub-surface flow systems are discussed. (CH)

9399 (CONF-7309108—2) **Induced stresses in hydraulic fracturing operations.** Shuck, L.Z.; Advani, S.H. (Bureau of Mines, Morgantown, W.Va. (USA). Morgantown Energy Research Center). 1973. 44p. Dep. NTIS $4.00.

From 15. symposium on rock mechanics; Custer, South Dakota, USA (Sep 1973).

The objectives of this work are to develop a better understanding of the mechanisms of the hydraulic fracturing process with emphasis placed upon stress analysis. A state-of-the-art discussion on the mechanics of the hydraulic fracturing process pertinent to stress analysis is presented. Basic phases of the process are defined. Two-dimensional and three-dimensional elasticity theory models are formulated and solved for the static field and local stress distribution during initial fluid injection that occur during a fracture extension phase. Computations of fluid flow pressure-time response affecting the stress contribution in a semi-infinite porous media are given. Analytical results are compared with corresponding experimentally-determined values from a laboratory model. (auth)

9400 (ORNL-tr—4057) **Prehistoric salt mine on the Hallstatt salt formation.** Hofmann, E.; Morton, F. Translated by R.G. Mansfield from *Wien. Praehist. Z.;* **15**: 82-101([nd]). 20p. Dep. NTIS $4.50.

Knowledge of the prehistoric mine in the Hallstatt salt mine workings, Austria, has been greatly extended and clarified in recent years. The microscopic study of residues of wood and excrement begun by the Hallstatt Museum, like that of new discoveries, has had remarkable results. The study of present operating conditions and of those of the Middle Ages made possible valuable comparisons. Thus it was possible to prepare a condensed descrip-

tion which mainly attempts to present a true picture of the technical problems of the ancient operation, as well as those of food supply. (auth)

9401 (ORNL-tr—4054) **Prehistoric salt mining at the Duerrnberg near Hallein.** Kyrle, G. 1913. Translated by E.G. Silver from Der praehistorische Salzbergbau am Duerrnberg bei Hallein. 122p. Dep. NTIS $5.50.

The geology, topography, and mineralogy of the Duerrnburg (dry hill) region near Hallein, Austria, are described. Archaeological specimens found in or near salt mines worked during neolithic times are discussed in relationship to the development of mining technology associated with the removal of salt beginning near the end of the Bronze Age. (CH)

9402 Canopy-understory interaction effects on forest population structure. Goff, F.G.; West, D. (Oak Ridge National Lab., TN). *For. Sci.*; **21**: No. 2, 98-108(Jun 1975).

A sequence of 49 small stands of increasing mean diameter from Menominee Forest in northern Wisconsin illustrates the development of stand structure. Density-diameter distributions of natural old-growth stands of small area or uniform structure are of a rotated sigmoid form rather than the previously reported negative exponential form. The negative exponential form seems characteristic of large forest tracts having localized patches of even-aged trees. In smaller stands where interactions between canopy and understory are important, the typical stand structure curve shows an understory phase of slow growth and high mortality, a vigorous canopy phase of relatively rapid growth and low mortality, and an older canopy phase of reduced growth and increasing mortality. (auth)

9403 Analysis of litterfall in a deciduous forest on Walker Branch Watershed, Tennessee: data stratification by two alternative methods. Grigal, D.F. (Univ. of Minnesota, St. Paul); Grizzard, T. *Am. Midl. Nat.*; **94**: No. 2, 361-369(Oct 1975).

Litterfall was monitored for 1 year on Walker Branch Watershed (97.5 ha) in eastern Tennessee. Data were collected from 80 plots, each with a 1 m^2 litter trap, and were stratified in two alternate ways for analysis. In one case, a conventional cover-type map was used to separate the plots into one of four cover types. In the other case, plots were separated into four groups based on multivariate stratification of overstory basal-area data. Subtle differences among strata in seasonal dynamics, total annual quantity, and elemental concentration of litterfall were detected better under the multivariate stratification than under the cover-type stratification. This study demonstrates that analysis of the structure of an ecosystem using multivariate techniques provides a firm basis for subsequent analysis of functions within that system. (auth)

9404 Possible climatic impact of tropical deforestation. Potter, G.L.; Ellsaesser, H.W.; MacCracken, M.C.; Luther, F.M. (Univ. of California, Livermore). *Nature (London)*; **258**: No. 5537, 697-698(25 Dec 1975).

A computer model of climate changes resulting from removal of tropical rain forests to increase arable acreage is described. A chain of consequences is deduced from the model which begins with deforestation and ends with overall global cooling and a reduction in precipitation. A model of the global water budget shows that the reduction in precipitation is accompanied by cooling in the upper tropical troposphere, a lowering of the tropical tropopause, and a warming of the lower tropical stratosphere. (HLW)

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 9398

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 8245, 9378, 9382, 9383, 9384

9405 (AERE-R—8103) **Cultivation and multi-element analysis of vegetables and grass in soil contaminated with trace elements.** Cawse, P.A.; Jones, I.S.; Cox, G.W. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1975. 24p. Dep. NTIS (US Sales Only) $3.50.

Growth of bean, carrot, lettuce, radish and grass in two soils of high pH that were contaminated by industrial waste has been examined. Inhibition of growth was alleviated by separate addition of peat or inorganic nitrogen to the soils, and sufficient vegetation was obtained for multi-element analysis of some 23 elements, mainly by instrumental neutron activation. The same relative concentrations of elements as found in acetic acid extracts of the soil were applied to sand cultures, and demonstrated that the order of toxicity to grass was Pb > As > Cu > Sb. The elemental composition of the soils and plants was compared with published data for "normal" media. Total Cu, As and Pb in one soil were present at 350 to 700 fold greater concentration than average, while 1000 to 2000 fold increase was shown by Ag, Sn and W. From 10 to 40 percent of Co, Zn and Pb was extractable with dilute acetic acid, but only 2 to 7 percent of Fe, Ni, As and Sb. The ratio of plant/soil-extractable element concentration averaged for all crops was ~0.5 for Ni and Cu, but <0.15 for Zn, As, Cd and Pb. Radish roots on contaminated soil showed at least an order of magnitude increase in As, Br, Cd, Sn, Sb and W concentrations compared with "normal" plant tissue, and concentrations of all elements were generally greater than found in edible parts of the other vegetables, except for slightly higher accumulation of Cd in lettuce and Sn in carrot. Concentrations of some elements in grass were higher than observed in vegetables, notably Cu, Zn, Se, Sn, Sb and W. Less accumulation of As, Cd, and Pb was found in bean pods and the roots of carrot and radish than in non-edible parts of these plants. (auth)

9406 (UCRL—5007-75-1, pp 35-36) **Environmental protection: monitoring ground water for pesticide residues.** 15 Aug 1975.

In Hazards control progress report No. 50, January—June 1975.

Chromatographic measurements of pesticide residues in LLL ground water are described. (GHT)

9407 Rapid method for the determination of fluoride in vegetation. Galloway, H.L.; Shoaf, R.E.; Skaggs, C.H. (Goodyear Atomic Corp., Piketon, OH). *Am. Ind. Hyg. Assoc. J.*; 721-724(Oct 1975).

An analytical procedure for the determination of fluoride in vegetation has been developed to aid in environmental studies. The method involves leaching the vegetation with a hot solution of strong base and then determining the fluoride in an acidified solution directly with a fluoride selective ion electrode. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 9100, 9323, 9394, 9395, 9396, 10149

9408 (IFTJ—73/I) **Proposal of the mathematical model of the aquifer for interpretation of measurements of natural isotopes in the water.** Nawalany, M. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1975. 76p. (In Polish). Dep. NTIS (US Sales Only) $4.50.

Mathematical models for use in isotope hydrology are presented. The most commonly used deterministic models are discussed, including the piston flow and good mixing models. The model of nonideal mixing is introduced into the hydrological considerations. This model is a generalization of the good mixing model and allows for different processes of mixing of natural isotopes in waters of hydrological systems. The most important stochastic model i.e., the dispersive model is also discussed. A three-velocities model is proposed that differs from the other models in following properties: it includes finite flow velocity of the tracer particles; it takes into account the presence of stagnant water; it satisfied the law of fluid continuity; and it is convergent to the piston-flow model in limit. (auth)

SOIL

REFER ALSO TO CITATION(S) 8330

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 9394, 9552

9409 (EDFB-IBP—74-2) **Interactive differential equations modeling program.** Rust, B.W.; Mankin, J.B. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 121p. Dep. NTIS $7.00.

Due to the recent emphasis on mathematical modeling, many ecologists are using mathematics and computers more than ever, and engineers, mathematicians and physical scientists are now included in ecological projects. However, the individual ecolo-

gist, with intuitive knowledge of the system, still requires the means to critically examine and adjust system models. An interactive program was developed with the primary goal of allowing an ecologist with minimal experience in either mathematics or computers to develop a system model. It has also been used successfully by systems ecologists, engineers, and mathematicians. This program was written in FORTRAN for the DEC PDP-10, a remote terminal system at Oak Ridge National Laboratory. However, with relatively minor modifications, it can be implemented on any remote terminal system with a FORTRAN IV compiler, or equivalent. This program may be used to simulate any phenomenon which can be described as a system of ordinary differential equations. The program allows the user to interactively change system parameters and/or initial conditions, to interactively select a set of variables to be plotted, and to model discontinuities in the state variables and/or their derivatives. One of the most useful features to the non-computer specialist is the ability to interactively address the system parameters by name and to interactively adjust their values between simulations. These and other features are described in greater detail. (auth)

SITE RESOURCE AND USE STUDIES

9410 (BNWL-B—448) **Heat sink management for a Hanford Nuclear Energy Center.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 43p. Dep. NTIS $5.45.

An interim account is given of the work being performed to develop a heat sink management plan for the conceptual study of a Hanford Nuclear Energy Center (HNEC). Primary attention has been focused on the tentative selection of sites for HNEC reactor plants and cooling system facilities. The locations of the sites must be taken into consideration when making choices between alternate cooling systems for a heat sink management plan. Ten reactor plant sites have been tentatively selected, each of which is potentially suitable for accommodating a cluster of at least four 1300 MWe units. Three sites, two of which are north of the Columbia River, have been tentatively selected for cooling lakes, and a potential route through the Hanford Reservation has been identified for a cooling canal. The criteria used in the site selection process and the locations of the sites and some of the geologic characteristics of the sites are discussed. The literature has been surveyed pertaining to the physical characteristics of the Columbia River, the standards governing permissible increases in river temperature due to thermal discharges, and the results of investigations that have been performed to assess the impacts of the Hanford plutonium production reactors which, until recently, discharged significant quantities of heated effluents to the Columbia River. (auth)

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 8810, 8811, 8816, 9373, 9375, 9414

RADIOMETRIC TECHNIQUES

9411 (COO—1771-6) **Nutrient cycling and productivity of dystrophic lake-bog systems (Part A). Technical progress report, December 1, 1972—September 30, 1975.** Hooper, F.F. (Michigan Univ., Ann Arbor (USA)). Oct 1975. Contract AT(11-1)-1771. 59p. Dep. NTIS $5.50.

A sampler and an analytical and characterization scheme were developed to investigate the chemical and physical state of iron in a highly stained acid bog lake. Iron fractions were chemically separated by reactivity to bathophenanthroline (BPN) after specific digestion procedures. Physical separation involved anaerobic in situ filtration (450 nm), and in situ dialysis (4.8 nm). This resulted in three size classes: particulate, colloidal, and dissolved. Unlike pH 6-8 lakes, inorganic, nonreactive species of iron [e.g., $Fe(OH)_3$] represent minor amounts of the total iron in North Gate Lake. In situ radiochemical analyses revealed that colloidal sized reactive ferric iron predominates in the oxygenated epilimnion, while dialyzable or dissolved ferrous iron increases with depth. Unlike iron, organic matter is present in a nontransient colloidal state. In acid (pH 4-5) bog lakes ferric iron is not colloidal as an inorganic complex (OH^-), but colloidal as reactive Fe^{+3} by complexation with the colloidal organic acids. After thermally induced mixing with anaerobic waters, ferric iron is reduced and dissolved. However, some of the BPN reactive iron remains colloidal suggesting the presence of a residual ferrous organic complex. (auth)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 8282, 8283, 8284, 8295, 9378, 9379, 9380, 9381, 9382, 9383, 9384

9412 (CONF-750530—3) **Potential trace metal contamination of water resources through the disposal of fly ash.** Theis, T.L. (Notre Dame Univ., Ind. (USA)). 1976. 21p. Dep. NTIS $3.50.

From 2. national conference on complete water use; Chicago, Illinois, USA (4 May 1975).

Increased emphasis on the control of particulate air pollutants has led to the widespread collection of fly ash by coal burning agencies. This, in turn, has generated a disposal problem of great magnitude. Common disposal practice for this material involves contact with both surface and sub-surface water supplies. Of particular concern are the pH, dissolved oxygen, and heavy metal leachate effects on aquatic resources. Data are presented on these factors and a discussion of the chemical and biological mechanisms of importance is given. (auth)

9413 (IS-M—57) **Resin sorption methods for monitoring selected contaminants in water.** Junk, G.A.; Richard, J.J.; Fritz, J.S.; Svec, H.J. (Ames Lab., Iowa (USA)). 1975. 44p. (CONF-751150—4). Dep. NTIS $4.00.

From 1. chemical congress of North American Continent; Mexico City, Mexico (30 Nov 1975).

Applications of XAD-2 resin sorption methods for the convenient monitoring of selected lipophilic contaminants in water are discussed. In one extensive study the concentrations of three pesticides, atrazine, DDE and dieldrin, in various surface, sub-surface and finished waters, were measured. The amounts ranged from several micrograms to less than one nanogram per liter (ng/l) of water. Surface water from every major watershed in the State of Iowa (U.S.A.) had appreciable levels of contamination with seasonal and climatic fluctuations which were consistent with an agricultural runoff model. Waters from shallow wells and from water treatment plants were also contaminated. The contamination was either not detected or found at less than one ng/l in water from deep wells located outside the alluvial plain of contaminated rivers. Water treatment processes, even charcoal bed filtration as employed at one modern treatment plant, were shown to be ineffective in reducing the pesticide concentration. Other applications and tests of the resin sorption method for monitoring selected organic contaminants are presented. (auth)

9414 (LBL—1(Vol.2)(Add.2)) **Survey of instrumentation for environmental monitoring. Volume 2. Water. Addition No. 2.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. vp. LBL $7.00.

A comprehensive survey of instrumentation for environmental monitoring is being carried out by the Lawrence Berkeley Laboratory under a grant from the National Science Foundation and the Energy Research and Development Administration. Instruments being investigated are those useful for measurements in Air Quality, Water Quality, Radiation, and Biomedicine related to environmental research and monitoring. Consideration is given to instruments and techniques presently in use and to those developed for other purposes but having possible applications to this work. The results of the survey are given as (a) descriptions of the physical and operating characteristics of available instruments, (b) critical comparisons among instrumentation methods, and (c) recommendations of promising methodology and development of new instrumentation. An update to the volume on water is presented. Sections added include I. Introduction; II. Metals; V. Biological Parameters; VII. Pesticides, Insecticides, Herbicides, Fungicides, Trace Toxic Compounds; VIII. Phenolics; IX. Petrochemicals; and X. Oil and Grease. (WHK)

9415 (NTIS/PS—75/698) **Water pollution in estuaries and coastal zones. A bibliography with abstracts. Search period covered: 1964—July 1975.** Brown, R.J. (National Technical Information Service, Springfield, Va. (USA)). Sep 1975. 239p. NTIS $25.00.

This bibliography contains selected abstracts of research reports covering studies dealing with water pollution from estuarine and coastal development, the effects of this pollution, and its control. The reports are general in nature so as to be of interest to any coastal area. The topics include pollution as related to urbanization, government actions, coastal planning, natural resource

development, and sewage and solid waste disposal. Specific biological and oceanographic studies have been excluded. (Contains 214 abstracts) (NTIS)

9416 (TID—26973) **Contamination of groundwater by heavy metals from the land disposal of fly ash. Progress report, June 1, 1975—September 30, 1975.** Theis, T.L.; Marley, J.J. (Notre Dame Univ., Ind. (USA)). 1975. Contract E(11-1)-2727. 12p. Dep. NTIS $3.50.

The purpose of this study is three-fold: to gather data from both the laboratory and field for purposes of assessing the impact of heavy metal leachates of fly ash on local water quality; to investigate the mechanisms of heavy metal attenuation in different soil environments; and to evaluate a ground water quality model for heavy metals to be used for managerial and predictive purposes. (ERB)

9417 (Y-JA—113) **Environmental impact of chemicals washed from preservative-treated wood.** DeMonbrun, J.R. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 4p. (CONF-760109—2). Dep. NTIS $3.50.

From The Cooling Tower Institute annual meeting; Houston, Texas, United States of America "USA" (Jan 1976).

The following conclusions can be stated as a result of this study: Whenever construction of new cooling towers or a major rebuilding of towers is proposed that utilizes Erdalith pressure-treated wood, the environmental impact on plant discharge from the chemical washed from the wood must be considered. Unless attempts are made to shield the treated wood from the weather, the amount of chemicals washed from the wood after erection is small in quantity; however, all values are above the EPA limits. For those systems not using chromate-based treatments it may be necessary (depending on the EPA permit) to contain the circulated water in the basin and remove the metals before allowing discharge. It may also be possible to obtain a variance to the permit. For systems using chromate-based treatments and destruction techniques to clean the water before discharge it should be determined if the chemicals from the wood (ie, arsenic) can be removed or else obtain a variance from the permit. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 9395, 9396, 10149

9418 (USGS—474-225) **Biochemical monitoring of water after the Cannikin event, Amchitka Island, Alaska, August 1974 and chemical monitoring from July 1972—June 1974.** Thordarson, W.; Ballance, W.C. (Geological Survey, Lakewood, Colo. (USA)). Mar 1976. Contract E(29-2)-474. 21p. Dep. NTIS $4.00.

Radiochemical data from the Amchitka Island study area were obtained from water samples collected by the U. S. Geological Survey during August 1974. Tritium determinations were made on 18 samples, and gross alpha and gross beta/gamma determinations were made on 12 samples. No appreciable differences were found between the data obtained during August 1974 and the data obtained before the Cannikin event. Chemical analyses were made on 4 samples collected in 1971, on 15 samples in 1972, on 11 samples in 1973, and 7 samples in 1974. Comparison of these analyses to analyses of samples collected before the Cannikin event indicates no changes outside of the seasonal range normally found at the sampling locations.

9419 (USGS—474-226) **Radiochemical monitoring of water after the Cannikin Event, Amchitka Island, Alaska, May 1974.** Thordarson, W.; Ballance, W.C. (Geological Survey, Lakewood, Colo. (USA)). Mar 1976. Contract E(29-2)-474. 21p. Dep. NTIS $4.00.

During May 1974, the U. S. Geological Survey collected water samples from Amchitka Island, Alaska. Tritium determinations were made on 99 water samples, and dissolved gross alpha and gross beta/gamma determinations were made on 34 water samples. No appreciable differences were found between the data obtained in May 1974 and the data obtained before the Cannikin nuclear explosion.

9420 Sublethal effect of 5-chlorouracil on carp (Cyprinus carpio) larvae. Eyman, L.D. (Oak Ridge National Lab., TN); Gehrs, C.W.; Beauchamp, J.J. *J. Fish. Res. Board Can.*; **32**: No. 11, 2227-2229(1975).

The sublethal effects of 5-chlorouracil, expressed as gross anatomical malformations, on newly hatched carp (Cyprinus carpio) larvae are presented. The percent malformed of those hatched was 1.2 at 0.5 ppm, 2.1 at 1.0 ppm, 2.7 at 5.0 ppm, and 4.3 at 10 ppm. Both a least-squares fit of a hyperbolic model and a linear-regression fit are used to describe the response. The malformations are an incremental effect of exposure to a toxicant which should be considered in addition to egg mortality in assessing the effect of environmental toxicants on populations. (auth)

WATER

REFER ALSO TO CITATION(S) 8314

THERMAL EFFLUENTS MONITORING AND TRANSPORT

9421 (DP—1398) **Clam survival in chlorinated water.** Tilly, L.J. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 10p. Dep. NTIS $4.50.

Applications of 10 to 40 ppM chlorine were ineffective in control of Asiatic clams that had colonized the suction well of a cooling water pump for one of the Savannah River production reactors. Accumulated mud on the floors and walls of the basin protected large numbers of clams from lethal chlorine exposures. After clams were removed from chlorine exposures of 9, 17, 25, and 54 hours, respective survivals after seven days in a recovery chamber were 97 percent, 84 percent, 47 percent, and 10 percent. Of the clams that were protected by mud during the entire test (54 hours), 65 percent were alive after seven days in the recovery chamber. (auth)

9422 (PB—240285) **Effect of meteorological variables on temperature changes in flowing streams. Ecological research series (final).** Troxler, R.W. Jr.; Thackston, E.L. (Vanderbilt Univ., Nashville, Tenn. (USA). Dept. of Environmental and Water Resources Engineering). Jan 1975. 86p. NTIS $4.75.

A mathematical model for predicting the change in water temperature in a flowing stream as a function of stream geometry and standard weather information was developed and tested. Five field tests were conducted on cold water released from hydropower stations as it warmed up moving downstream over periods up to 38 hours. (GRA)

REGULATIONS

9423 (EPA—600/5-74-030) **Evaluation of marketable effluent permit systems.** deLucia, R.J. (Meta Systems, Inc., Cambridge, Mass. (USA)). Sep 1974. Contract 68-01-1882. 361p. GPO $4.15.

This report is a study of the practical problems and prospects of using marketable effluent permits (MEP) as a water pollution control tool. Under such a system, pollution rights are contingent upon possession of permits; the permits are acquired and/or traded through an auction or market. This study details the requirements of MEP systems, discusses their theoretical advantages, and examines them through the use of industrial organization theory, comparisons with analogous markets, and a simulation model. The simulation model employs Mohawk River data to determine the effect of different system parameters on the operation of a MEP system. The legal and administrative aspects of the marketable permit system are also dealt with. The conclusion is that marketable permits are a promising control tool for many river basins. (auth)

BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 9330

9424 Cell-cycle-specific changes in chromatin organization. Hildebrand, C.E.; Tobey, R.A. (Los Alamos Scientific Lab., NM). *Biochem. Biophys. Res. Commun.*; **63**: No. 1, 134-139(3 Mar 1975).

Cell-cycle-specific changes in the organization of chromatin have been observed using the natural polyanion heparin as a probe. The heparin-mediated release of DNA from intact nuclei has been measured in mitotically synchronized populations of Chinese hamster (line CHO) cells during early interphase. Changes in the patterns of release of DNA from nuclei at different times post-mitosis suggest that significant changes in the organization of chromatin occur during G_1. These changes may be related to G_1-specific histone modification.

BEHAVIORAL BIOLOGY

9425 (BNWL—1931) **Diets of black-tailed hares on the Hanford Reservation.** Uresk, D.W.; Cline, J.F.; Rickard, W.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1975. Contract E(45-1)-1830. 43p. Dep. NTIS $5.00.

A fecal pellet analyses showed that black-tailed hares (jackrabbits) were selective in plants chosen as food. The most abundant herbaceous plant, cheatgrass, was not found in the pellets. Sagebrush and bitterbrush, woody plants, were not an important part of the hares' diet. Forbs, rabbitbrush, and certain grass species were preferred foods. (auth)

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 9150, 9430, 9476, 9506

9426 (BNL—20753) **Advantages of neutron scattering for biological structure analysis.** Schoenborn, B.P. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 16p. (CONF-750629—7). Dep. NTIS $3.50.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

The advantages and disadvantages of neutron scattering for protein crystallography, scattering from oriented systems, and solution scattering are summarized. Techniques for minimizing the disadvantages are indicated. (JSR)

9427 (CONF-7509103—1) **Turnover of ouabain-binding sites and plasma membrane proteins in HeLa cells.** Cook, J.S.; Will, P.C.; Proctor, W.R.; Brake, E.T. (Oak Ridge National Lab., Tenn. (USA); Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences). 1976. 49p. Dep. NTIS $4.00.

From 29. annual meeting of the Society of General Physiologists on biogenesis and turnover of membrane molecules; Woods Hole, Massachusetts, United States of America "USA" (5 Sep 1975).

Studies were conducted on the turnover of a specific molecule, inactivated by a specific drug, in the plasma membrane of a cloned cell line. The molecule, the Na^+-K^+ transport enzyme, was labeled with the inactivating ligand ^{3}H-ouabain. The cell line was HeLa S_3 which binds ouabain tightly but not covalently. Although ouabain was used primarily as a marker to locate the transport enzyme, ouabain is also representative of an important class of drugs, the cardiac glycosides, and the manner in which such drugs are handled by cells is a matter of pharmacological interest. It is suggested that the polypeptides in the membrane-rich fraction are turning over at different rates, but that they appear to be internalized as particulates of membrane-bound vesicles. (HLW)

9428 (CONF-751070—1) **Biochemist's view of the mediators of cellular immunity, with special reference to transfer factor.** Novelli, G.D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 17p. Dep. NTIS $4.50.

From 2. workshop on transfer factor U. S. Army Medical Research; Fort Detrick, Maryland, United States of America "USA" (5 Oct 1975).

The results of attempts to fractionate tumor-specific transfer factor by two chromatographic procedures that differ greatly in their basic separation principles have been presented. The behavior of the TF in these separation procedures led to the suggestion that TF prepared by the Lawrence procedure does not contain a single unique molecular species, but rather consists of a multiple collection of different molecular species differing from each other in both size and charge. Since each of these separated fractions have specific biological activity, it suggests that each of the different molecular species contains a common unique property that results in the conversion of a null or negative lymphocyte into a tumor specific killer cell. These facts led to the suggestion of a theory that TF prepared by the Lawrence procedure is derived by enzymatic degradation of a larger, non-dialyzable molecule, possibly the so-called immune RNA, by degradative enzymes released from lysozomes during the preparative procedures. These enzymatically derived products share a common unique property that causes them to be recognized by the appropriate lymphocyte so that they are taken up by the cell. Once these products are inside of the lymphocyte they are then converted, by as yet unknown steps, to the larger molecule which then causes the lymphocyte to develop specific cytotoxicity. (auth)

9429 (COO—3083-11) **Nucleic acids and protein synthesizing mechanisms of mitochondria. Progress report No. 11.** Suyama, Y. (Pennsylvania State Univ., University Park (USA). Dept. of Biology). 1974. Contract E(11-1)-3083-11. 5p. Dep. NTIS $3.50.

Progress is reported on studies of biochemical and molecular mechanisms involved in the synthesis of DNA and RNA in mitochondria of Tetrahymena and Hemophilus influenza. (CH)

9430 (LBL—4417) **Uptake and metabolism of nitrogen oxides in blood.** Case, G.D.; Schooley, J.C.; Dixon, J.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 12 Nov 1975. Contract W-7405-Eng-48. 23p. (CONF-760221—1). Dep. NTIS $3.50.

From 20. annual meeting of the Biophysical Society; Seattle, Washington, United States of America "USA" (24 Feb 1976).

The reactions of hemoglobin and whole blood with nitrogen oxides, generally very high doses, are reviewed. This work describes the formation of nitroxyhemoglobin (Hb—NO) and its direct conversion to methemoglobin (met—Hb) in vitro, as well as the effects of human exposure to typical combustion effluents. Whole blood from mice was exposed to an NO atmosphere, resulting in the in vitro formation of Hb—NO, low-spin met—Hb, and high-spin met—Hb (measured by electron paramagnetic resonance spectroscopy). Hematocrit analysis revealed to hemolysis during the exposure. Subsequent exposure to clean air after purging results in the disappearance of Hb—NO with a 2-hour half-time. This is accompanied by the simultaneous and stoichiometric appearance of high-spin met-Hb. No low-spin met-Hb is produced from the decay of Hb—NO. In addition, human and rabbit blood specimens were obtained during in vivo exposure to 1 to 3 ppM NO, 0.3 ppM NO_2, and up to 50 ppM CO. These pollutant levels (especially NO and NO_x) are typical of the home environment during operation of combustion appliances. (auth)

9431 (LF-tr—120) **Studies on the degradation of collagen by rat organs. Differentiation and characterization of proline peptide-splitting enzymes.** Kirschke, H.; Hanson, H. Translated from *Z. Physiol. Chem.*; **350**: 1437-1448(1969). 26p. Dep. NTIS $4.00.

A few compounds--dipeptides and tripeptides containing proline and glycine, poly-Pro, a pentapeptide protected at the amino end (Pz-Pro-Leu-Gly-Pro-D-Arg), and a collagen preparation (acid-soluble collagen)--were studied for enzyme hydrolyzability by rat organ homogenates, organ cell fractions, and electrophoresis fractions from the cytosol of some organs. The following were some of the findings: 1. Prolinase, prolidase, and a Pro-Gly-Gly-splitting tripeptidase are localized in the cytosol of the kidney and liver. 2. The prolinase in the rat organs cannot be activated by the addition of Cd^{2+}, unlike the prolinase from swine kidneys. 3. The prolidase from the cytosol from the liver, kidneys, lungs, and brain of the rat migrates farthest toward the anode during electrophoresis (paper and carrier-free electrophoresis pH 7.4 to 8.6). 4. The relative rates of hydrolysis of Pro-Gly-Gly and Gly-Gly-Gly differ greatly in the organs studied. The Pro-Gly-Gly-splitting activity is localized in the cytosol of the kidney and the Gly-Gly-Gly-splitting activity is located in the microsome fraction. 5. Slight hydrolysis of the synthetic collagenase substrate could be demonstrated only in the kidney and uterus homogenate. 6. The collagen preparation was hydrolyzed weakly by trypsin and chymotrypsin after incubating for one hour at 30°C, and was hydrolyzed more markedly by the kidney homogenate. Hydrolysis of collagen was demonstrated by determinations of hydroxyproline, residual nitrogen, α-amino nitrogen, and by determinations of nitrogen according to Lowry. (auth)

9432 **^{35}Cl nuclear magnetic resonance studies of anion-binding sites in proteins: lactate dehydrogenase.** Ward, R.L. (Univ. of California, Livermore). *Arch. Biochem. Biophys.*; **169**: 22-28(1975).

^{35}Cl nmr relaxation rate measurements have been used to study anion-binding sites in pig heart lactate dehydrogenase. These studies reveal two types of sites, one is intimately associated with the active site, the other is not. The nonactive site has been ascribed to a subunit site in analogy with crystallographic results from the dogfish M_4 enzyme. The binding of either the reduced or the oxidized form of NAD results in an increase in the ^{35}Cl nmr relaxation rate by a factor of 1.8-2. The enhanced nmr relaxation rate of the binary lactate dehydrogenase—NAD complex is reduced on binding of the substrate inhibitor molecules oxamate or oxalate to a value less than that exhibited by lactate dehydrogenase alone. The enhancement of the nmr relaxation rate is attributed to a decrease in the dissociation constant of Cl^- for the enzyme. The K/sub D/ values for Cl^- binding to the active center site of lactate dehydrogenase are 0.85 M and for lactate dehydrogenase—NADH is 0.25 M. The ratio of these constants, 3.4, agrees well with the measured enhancement value 3.7. The effect of coenzyme analogs on the ^{35}Cl nmr relaxation rate has been examined. 3-Acetylpyridine NAD produces an enhancement of 4.3, thionicotinamide NAD of 2.3, whereas 3-pyridinealdehyde, adenosinediphosphoribose, and adenosine diphosphate do not affect the nmr relaxation state of Cl^- bound to lactate dehydrogenase. (auth)

9433 Automated elution electrophoresis: a potential clinical tool. Scott, C.D.; Lee, N.E.; Perkins, A.W. (Oak Ridge National Lab., TN). *Clin. Chem.*; **21**: No. 9, 1217-1220(Aug 1975).

From 7. annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975).

See CONF-750319—.

An elution electrophoresis system in which a porous packed bed is used for separation and a flow photometer or colorimeter for continuous monitoring of the eluate may be capable of rapid, high-resolution analysis of serum proteins and other protein mixtures with very little manual labor. In a prototype of such a system we used a cooled separations column, 3 mm in diameter and 40 cm long, containing polyacrylamide beads. Samples are introduced, via a microsyringe, through a septum at the column midpoint. Typical analyses for serum proteins or serum isoenzymes require an electrophoresis time of about 30 min at 1200 V. (auth)

9434 Variable temperature computerized dual-beam, rapid scanning stopped-flow apparatus for the study of air-sensitive systems and transients in enzyme reactions. Papadakis, N.; Coolen, R.B.; Dye, J.L. (Michigan State Univ., East Lansing). *Anal. Chem.*; **47**: No. 9, 1644-1649(Aug 1975).

A double-beam, vacuum tight, thermostated stopped-flow apparatus has been constructed and computer interfaced. A specially designed all-quartz mixing and observation cell equipped with a double mixer and two optical path lengths has been used. The syringes were made out of heavy-walled precision bore Pyrex tubing. Steel plungers with adjustable Teflon tips were machined to fit them. The entire apparatus was constructed such that the solutions contact only Pyrex, quartz, and Teflon, while the flow system is surrounded by a thermostat bath. Quartz fiber optics were utilized to transmit the dispersed light from a Perkin—Elmer Model 108 rapid-scan monochromator to the flow and reference cells and then to a pair of photomultipliers. The performance of the system has been tested by studying a number of well characterized chemical reactions. (auth)

9435 Purification of tryptophan transfer RNA from chick cells and its identity with "Spot 1" RNA of Rous sarcoma virus. Waters, L.C. (Oak Ridge National Lab., TN); Yang, W.K.; Mullin, B.C.; Nichols, J.L. *J. Biol. Chem.*; **250**: No. 16, 6627-6629(25 Aug 1975).

Tryptophan transfer RNA from chick cells chromatographs reacts differently in the reversed-phase column chromatographic system 5 depending upon whether it is aminoacylated or not. This property was utilized to prepare pure tryptophan tRNA. Oligonucleotide fingerprints of tryptophan tRNA purified in this manner are identical with those reported for "spot 1" RNA isolated from Rous sarcoma virus. (auth)

9436 Enzymic formation of 6-oxobenzo[a]pyrene radical in rat liver homogenates from carcinogenic benzo[a]pyrene. Lesko, S.; Caspary, W.; Lorentzen, R.; Ts'o, P.O.P. (Johns Hopkins Univ., Baltimore). Contract AT(11-1)-3280. *Biochemistry*; **14**: No. 18, 3978-3984(9 Sep 1975).

From 19. annual meeting of the Biophysical Society; Philadelphia, PA (1975).

Upon incubation of benzo[a]pyrene (B[a]P) at 37° in rat liver homogenates fortified with NADPH generating cofactors, a metabolite was formed which gave rise spontaneously to an electron paramagnetic resonance (EPR) signal. The radical and its metabolic precursor were extracted into benzene for measurement, in which they are relatively stable. The EPR signal was identical with that extracted after incubating synthetic 6-hydroxybenzo[a]pyrene (6-OH-B[a]P) in rat liver homogenates and has been identified as the 6-oxobenzo[a]pyrene radical by its characteristic hyperfine structure. No EPR signal was detected when benzo[a]pyrene or cofactors were eliminated from the incubation mixture or when the homogenate was heated. The radical concentration reached a peak after 14-15 min of incubation and declined rapidly to a low level at 20 min. The decay of 6-hydroxybenzo[a]pyrene in rat liver homogenate did not appear to be enzymic and showed a first-order rate constant of 0.29 min^{-1} and a half-life of 2.4 min. The only significant products formed by oxidation of 6-hydroxybenzo[a]pyrene in rat liver homogenates were: 6,12-B[a]P dione (15 percent), 1,6-B[a]P dione (41 percent), and 3,6-B[a]P dione (44 percent). Formation of 6-OH-B[a]P was found to represent about 18 and 20 percent of total metabolism for female Sprague-Dawley rats and female ACI rats, respectively. The data indicate that 6-OH-B[a]P is a major metabolite of benzo[a]pyrene. This metabolite is very labile, being readily oxidized to the 6-oxobenzo[a]pyrene radical which is a transient intermediate in the further oxidation to quinones. (auth)

9437 Influence of an aggregated multienzyme system on transient time: kinetic evidence for compartmentation by an aromatic-amino-acid-synthesizing complex of Neurospora crassa. Welch, G.R.; Gaertner, F.H. (Oak Ridge National Lab., TN). *Proc. Natl. Acad. Sci. U.S.A.*; **72**: No. 11, 4218-4222(Nov 1975).

The aromatic complex of Neurospora crassa is an aggregated multienzyme system which catalyzes five consecutive reactions in the central pathway leading to the biosynthesis of the aromatic amino acids. In an attempt to understand the physiological importance of this complex in particular, as well as the importance of cellular organization of enzyme systems in general, we have isolated the complex and have begun to characterize its catalytic properties. Optimum conditions for the assay of the overall 5-step reaction catalyzed by the partially purified complex have been determined. An analog computer was programmed to represent an unaggregated system of five enzymes with rate constants identical to those found for the constituent enzymes of the complex. By direct comparison, it was shown that the lags (transient times) obtained for the overall reaction were 10-15 times longer for the hypothetical unaggregated system than for the complex. We conclude from these data that the aggregated multienzyme system compartmentalizes intermediate substrates during the course of the overall reaction. (auth)

9438 Identification of NADPH-thioredoxin reductase system in Euglena gracilis. Munavalli, S.; Parker, D.V.; Hamilton, F.D. (Oak Ridge National Lab., TN). *Proc. Natl. Acad. Sci. U.S.A.*; **72**: No. 11, 4233-4237(Nov 1975).

Euglena gracilis contains a protein system which can utilize the reducing power of NADPH in the ribonucleotide reductase-catalyzed reduction of CTP. The proteins required for this reaction are a flavoprotein with a molecular weight of approximately 185,000 which is functionally similar to thioredoxin reductase (NADPH), EC 1.6.4.5, and another protein (Protein I) whose function in the reaction is unknown. This new protein does not appear to contain a prosthetic group and has a molecular weight of approximately 240,000. In addition, the ribonucleotide reductase active in the Euglena NADPH-thioredoxin reductase system is more complex than the protein reported in a previous publication. The enzyme preparation described in this report contains four different types of polypeptide chains which may complex to form the active enzyme. (auth)

9439 Translation of RNA that contains polyadenylate from yeast mitochondria in an Escherichia coli ribosomal system. Padmanaban, G.; Hendler, F.; Patzer, J.; Ryan, R.; Rabinowitz, M. (Univ. of Chicago). *Proc. Natl. Acad. Sci. U.S.A.*; **72**: No. 11, 4293-4297(Nov 1975).

RNA that contains poly(A) [poly(A)-RNA] has been isolated from yeast mitochondria by poly(U) Sepharose-4B column chromatography. Pulse-labeled poly(A)-RNA shows 8-10 discrete peaks by acrylamide gel electrophoresis. The specific activity of mitochondrial poly(A)-RNA is six to eight times greater than that of mitochondrial rRNA after pulse labeling of protoplasts with [^{3}H]uridine. Ethidium bromide inhibits incorporation by over 90 percent. The total mitochondrial RNA preparation was contaminated with 5-15 percent cytoplasmic rRNA as determined by gel electrophoresis, but RNA exhaustion hybridization experiments indicated little or no cytoplasmic contamination of the mitochondrial poly(A)-RNA. The poly(A)-RNA stimulates [^{3}H]leucine incorporation into protein in an E. coli cell-free system. A fraction of the labeled product is precipitated with antibody directed toward yeast cytochrome oxidase, but not with antibody directed toward bovine serum albumin. Sodium dodecyl sulfate gel electrophoresis of the immunoprecipitated material reveals labeled peptides having the mobility of the three larger cytochrome oxidase peptides, which are known to be translated by mitochondrial ribosomes. (auth)

9440 Structural properties of pyruvate carboxylases from chicken liver and other sources. Barden, R.E.; Taylor, B.L.; Isohashi, F.; Frey, W. II; Zander, G.; Lee, J.C.; Utter, M.F. (Case Western Reserve Univ., Cleveland). *Proc. Natl. Acad. Sci. U.S.A.*; **72**: No. 11, 4308-4312(Nov 1975).

Varieties of pyruvate carboxylase [pyruvate: CO_2 ligase (ADP-forming), EC 6.4.1.1] obtained from the livers of several species of vertebrates, including humans, all show the same basic structure. They are composed of large polypeptide chains of molecular weights ranging from 1.2 to 1.3 x 10^5 for the different varieties of the enzyme. The native form of the enzyme appears to be a tetramer with a molecular weight of about 5 x 10^5. In the case of pyruvate carboxylase from chicken liver each polypeptide chain contains a biotin moiety, thus supporting the thesis that the tetramer contains four identical polypeptide chains. Pyruvate carboxylase from yeast appears to be basically similar to those from the vertebrate species and has a tetrameric structure. Each protomer contains a single polypeptide chain with a molecular weight of 1.25 x 10^5. In contrast, pyruvate carboxylase from two bacterial species, Pseudomonas citronellolis and Azotobacter vine-

landii, appears to be a dimer with a molecular weight (2.5 x 10^5) about half that of the animal and yeast species. As a further difference, each of the protomers of the bacterial enzymes contain two polypeptides of 6.5 and 5.4 x 10^5 molecular weight in the case of the Pseudomonas enzyme. The larger of the two polypeptides contains the biotin moiety. The functional units of the bacterial enzyme thus appear to contain two polypeptides while that of the liver and yeast enzymes is made up of a single chain. Neither of these arrangements corresponds with those of other biotin enzymes whose structure has been extensively studied (acetyl-CoA carboxylases from liver or Escherichia coli, and transcarboxylase from Propionibacterium). (auth)

9441 Applications of synchrotron radiation to protein crystallography: preliminary results. Phillips, J.C.; Wlodawer, A.; Yevitz, M.M.; Hodgson, K.O. (Stanford Univ., CA). *Proc. Natl. Acad. Sci. U.S.A.*; **73**: No. 1, 128-132(Jan 1976).

X-ray diffraction photographs of protein single crystals have been obtained using synchrotron radiation produced by an electron-positron storage ring. The diffracted intensities observed with this unconventional source are a factor of at least 60 greater than those obtained with a sealed x-ray tube using the same crystal and instrumental parameters. Diffraction data have been collected by the precession method to higher resolution and using smaller protein crystals than would have been possible with a conventional source. The crystal decay rate in the synchrotron beam for several proteins appears to be substantially less than that observed with Ni-filtered Cu radiation. The tunable nature of the source (which allows selective optimization of anomalous contributions to the scattering factors) and the low angular divergence of the beam make the source very useful for single crystal protein diffraction studies. (auth)

TRACER TECHNIQUES

9442 N-glycosidase activity in extracts of Bacillus subtilis and its inhibition after infection with bacteriophage PBS2. Friedberg, E.C.; Ganesan, A.K.; Minton, K. (Stanford Univ., CA). *J. Virol.*; **16**: No. 2, 315-321(Aug 1975).

We have detected in crude extracts of Bacillus subtilis an N-glycosidase activity which catalyzes the release of free uracil from DNA of the subtilis phage PBS2 labeled with [^{3}H]uridine. This DNA contains deoxyuridine instead of thymidine. The enzyme is active in the presence of 1.0 mM EDTA and under these conditions Escherichia coli or T7 DNA labeled with [^{3}H]thymidine is not degraded to labeled acid-soluble products. The activity resembles an N-glycosidase from E. coli which releases free uracil from DNA containing deaminated cytosine residues. Both enzymes in crude extracts are active in the presence of EDTA, do not require dialyzable co-factors, and have the same pH optimum. They differ in that the enzyme from E. coli is more sensitive to heat, sulfhydryl reagents, and salt. The enzyme from B. subtilis is inactive on DNA containing 5-bromouracil or hydroxymethyluracil. Extracts of PBS2-infected B. subtilis lose the N-glycosidase activity within 4 min after infection and contain a factor that inhibits the N-glycosidase activity in extracts of uninfected cells in vitro. (auth)

CYTOLOGY

REFER ALSO TO CITATION(S) 9102, 9360, 9479

9443 (BNL—20807) **Notions about human stem cells.** Cronkite, E.P.; Feinendegen, L.E. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 39p. (CONF-7509111—1). Dep. NTIS $4.00.

From Symposium on preleukemic states; Paris, France (19 Sep 1975).

Precise characterization of the structure of hemopoiesis in man and its quantitation is required for an understanding of hemopoietic regulation and its response to toxic agents, during and after chemotherapy and radiotherapy, in the course of various diseases, and in individuals exposed to agents known to be or which may be toxic to the bone marrow. Knowledge of stem cell kinetics derives almost exclusively from studies on the mouse. The degree to which this can be applied to man is not known. Mouse and human studies indicate that there is a pluripotent hemopoietic stem cell (PHSC) pool in which less than 20 percent of the cells are in DNA synthesis. The PHSC pool feeds into the committed stem cell (CSC) pools (erythrocytic, granulocytic-monocytic and megakaryocytic lines). The CSC has about 30 to 40 percent of its cells in DNA synthesis under normal steady state conditions. Data on mouse and human stem cell proliferation are summarized.(CH)

9444 (CONF-751222—1) **Are nonrandom karyotypic changes related to etiologic agents.** Rowley, J.D. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. 4p. Dep. NTIS $3.50.

From Symposium on genetics and human cancer; Orlando, Florida, United States of America "USA" (1 Dec 1975).

The hypothesis that specific chromosome abnormalities are related to particular etiologic agents is considered. Three areas are considered: evidence for nonrandom changes, evidence in animals relating nonrandom changes to specific etiologic agents, and human neoplasms offering opportunities for investigating this question. Sarcomas produced by Rous sarcoma virus and DMBA in rats are discussed in relation to chromosomal patterns. (HLW)

9445 (LA-UR—76-459) **Karyotype analysis of Chinese hamster chromosomes by flow microfluorometry.** Deaven, L.L.; Stubblefield, E.; Jett, J.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 6p. (CONF-751158—1). Dep. NTIS $3.50.

From Workshop on automated cycogenetics; Pacific Grove, California, USA (30 Nov 1975).

Chromosomes from diploid and aneuploid Chinese hamster cells were isolated at neutral pH or following fixation in 50% acetic acid, stained with ethidium bromide, and analyzed by flow microfluorometry (FMF). In some experiments, the chromosomes were partially fractionated by zonal centrifugation on a sucrose gradient. FMF analysis produced a series of peaks and shoulders consistent with distributions expected on the basis of relative DNA content of the chromosomal components of these lines. Analysis of the fractions of partially purified chromosomes was consistent with visual microscopic determinations and demonstrated that specific chromosomes were associated with specific peaks in the FMF spectra. Partial separation of chromosomes according to size on sucrose gradients should facilitate the isolation of analyzable quantities of single chromosomes by electronic sorting. The spectra from euploid and aneuploid cells clearly demonstrate the usefulness of this method for rapid karyotype analysis from large numbers of cells. Subtle changes in chromosome morphology as revealed by G-band analysis can also be detected in flow systems.

9446 (LA-UR—76-525) **Flow microfluorometric approaches to cell kinetics.** Crissman, H.A.; Kissane, R.J.; Oka, M.S.; Tobey, R.A.; Steinkamp, J.A. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 28p. (CONF-760315—3). Dep. NTIS $4.00.

From 29. annual symposium on fundamental cancer research; Houston, Texas, United States of America "USA" (10 Mar 1976).

We have presented in this report data obtained by FMF analysis of in vivo model tumor systems and the in vitro CHO cell culture system in an effort to demonstrate a few of the biological applications of flow systems, particularly for use in cell kinetics and cell growth studies. Flow systems are no longer viewed as laboratory novelty items or "electronic gadgets," as they were referred to a decade or so ago. Experiments performed in laboratories throughout the world have provided credibility and respectability to this unique methodology.

9447 Biological effects of ultrasound on cultured mammalian cells. Martins, B.I.; Raju, M.R.; Hayes, T.L.; Tobias, C.A. (Univ. of California, Berkeley). *SPIE Semin. Proc.*; **47**: 167-173(1975).

9448 High-speed quantitative karyotyping by flow microfluorometry. Gray, J.W.; Carrano, A.V.; Moore, D.H. II; Steinmetz, L.L.; Minkler, J.; Mayall, B.H.; Mendelsohn, M.L.; Van Dilla, M.A. (Univ. of California, Livermore). *Clin. Chem.*; **21**: No. 9, 1258-1262(Aug 1975).

From 7. annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975).

See CONF-750319—.

We describe a new flow-system technique for high-speed quantitative karyotyping. Metaphase chromosomes are isolated from cells, stained with a DNA-specific fluorochrome, and individually measured for stain content at rates up to 10^5/min in a flow microfluorometer. The resulting distribution contains quantitative information about the relative frequency of occurrence and the chromosomal DNA content of the measured chromosomes. Such analyses of Chinese hamster chromosomes are in good agreement with independent results from scanning cytophotometry and with cytogenetic observations of the banded chromosomes. Analyses of two karyotypically different clones of Chinese hamster M3-1 lines provide the quantitative characterization of two stable translocations. Initial data on human chromosomes are presented and agree well with results of scanning cytophotometry and suggest potential clinical applications as preparative and instrumental techniques improve. (auth)

TRACER TECHNIQUES

9449 Cell-cycle dependent phosphorylation of serine and threonine in Chinese hamster cell F1 histones. Hohmann, P.; Tobey, R.A.; Gurley, L.R. (Los Alamos Scientific Lab., NM). *Biochem. Biophys. Res. Commun.*; **63**: No. 1, 126-133(3 Mar 1975).

The phosphorylation of serine and threonine was studied in chromatographically purified f1 histones from CHO cells. Two unphosphorylated parental f1 histone fractions were observed in G_1-arrested cells: a major (87%) and a minor (13%) fraction. An additional f1 fraction, a phosphorylated form of the major parent, was chromatographically resolved from exponentially growing cultures. This form of the f1 histone incorporated [^{32}P]phosphate into serine at a rate approximately 5 times greater than into threonine. In mitotic cells, virtually all of the f1 histone chromatographed as a distinct, highly phosphorylated form. This form of the f1 histone incorporated [^{32}P]phosphate more rapidly into threonine than into serine. The greatly enhanced rate of threonine phosphorylation in the FL histones of mitotic CHO cells was further confirmed by the isolation of a phosphothreonine-containing tryptic peptide virtually absent in exponentially growing cells.

GENETICS

9450 Chemical induction of presumed dominant-lethal mutations in postcopulation germ cells of mice. I. Relative sensitivity between pre- and postcopulation germ cells to isopropyl methanesulfonate. Suter, K.E. (Univ. of Tennessee, Knoxville). *Mutat. Res.*; **30**: 355-364(1975).

Females from (C_3H x 101)F_1 and a mixed stock were injected intraperitoneally with either 25 or 50 mg/kg isopropyl methanesulfonate (IMS) or Hanks' solution 4.5 h after the midpoint of the dark period during which mating occurred. It was determined that at the time of treatment the great majority of oocytes were undergoing second meiotic division. For comparison, the same doses of IMS were given to females treated within 3 to 5 days prior to mating (predominantly dictyate oocytes) or to males treated within 4 to 5 days prior to mating (sperm in vas and epididymis). The frequencies of presumed dominant lethals induced by 50 mg/kg IMS in sperm treated in vas and epididymis, dictyate oocytes, and germ cells in mated females are 22 percent, 19 percent, and 79 percent, respectively, for (C_3H x 101)F_1 and 26 percent, 30 percent, and 76 percent for the other stock. Clearly, in both stocks, effects in mated females, when both female and male germ cells were treated, are relatively much higher than the added effects on dictyate oocytes and spermatozoa. This is also true for the 25 mg/kg dose. (auth)

9451 Studies on the dominant-lethal and fertility effects of the heavy metal compounds methylmercuric hydroxide, mercuric hydroxide, mercuric chloride, and cadmium chloride in make and female mice. Suter, K.E. (Univ. of Tennessee, Knoxville). *Mutat. Res.*; **30**: 365-374(1975).

Dominant-lethal effects of 10 mg/kg methylmercuric hydroxide were studied in male mice from two hybrid stocks and in females from one of these stocks. Two other compounds, mercuric chloride (2 mg/kg) and cadmium chloride (2 mg/kg), were studied only in females for dominant-lethal (in one hybrid stock) and reproductive capacity effects (in two hybrid and one mixed stocks). All compounds were administered in a single intraperitoneal injection. When males of one of the two stocks studied were treated with methylmercuric hydroxide, the females to which they were mated exhibited a slight reduction in the total number of implantations and in the number of living embryos. These reductions were accompanied by a very small increase in the incidence of dead implantations. In females, cadmium chloride had no detectable dominant-lethal or other fertility effects, except superovulation. On the other hand, the two mercury compounds slightly reduced the numbers of implants and living embryos in females subjected to dominant-lethal studies. The two mercury compounds also induced a slight reduction in the long-term reproductive performance of one stock of females. These results, and those reported earlier by others, indicate that the mercury compounds studied so far are not potent inducers of dominant-lethal mutations in male and female mice. It is not clear whether the small effects on male or female fertility induced in some cases, particularly the increase in dead implantations and reductions in the number of living embryos, were attributable to dominant-lethal mutations or to nongenetic causes. (auth)

9452 GENETIC VARIABILITY OF THE ANTARCTIC BRACHIOPOD LIOTHYRELLA NOTORCADENIS AND ITS BEARING ON MASS EXTINCTION HYPOTHESES. Ayala, F.J.; Valentine, J.W.; Delaca, T.E.; Zumwalt, G.S. New York; United States of America (USA); Society of Economic Paleontologists and Mineralogists (1975). 9p.

Genetic variation has been studied in 34 loci coding for soluble proteins and enzymes in a natural population of the brachiopod Liothyrella notorcadensis from Antarctica. The proportion of polymorphic loci is 23.5 percent, and the average proportion of heterozygous loci per individual is 3.9 +- 1.9 percent. Thus L. notorcadensis is one of the least genetically variable invertebrate species yet studied. With respect to hypotheses of the ecological regulation of genetic variability, our results favor models that correlate low genetic variability with instability in trophic resource supplies. To this extent also our results favor extinction models that predict high genetic variability that promotes specialization in the inhabitants of stable regimes; these inhabitants would tend to become extinct when environments become unstable or otherwise change significantly. (auth)

9453 Tests for the mutagenic action of a number of chemicals on Haemophilus influenzae with special emphasis on hydrazine. Kimball, R.F.; Hirsch, B.F. (Oak Ridge National Lab., TN). *Mutat. Res.*; **30**: 9-20(1975).

A number of chemicals have been tested for their ability to produce novobiocin-resistant mutants in Haemophilus influenzae. Of these, hydrazine (HZ) proved unique because it induced a fairly high incidence of mutation without killing significant numbers of cells at concentrations ranging over nearly four orders of magnitude. Moreover, its dose—effect curve increased very slowly initially and reached a relatively low maximum. It is suggested that HZ may be acting as both a mutagen and an antimutagen in this system. (auth)

9454 Fitness of allozyme variants in Drosophila pseudoobscura. II. Selection at the Est-5, Odh and Mdh-2 loci. Marinkovic, D.; Ayala, F.J. (Univ. of California, Davis). *Genet. Res.*; **24**: 137-149(1975).

We have studied the effects on fitness of allelic variation at three gene loci (Est-5, Odh, and Mdh-2) coding for enzymes in Drosophila pseudoobscura. Genotype has a significant effect on fitness for all six parameters measured (female fecundity, male mating capacity, egg-to-adult survival under near-optimal and under competitive conditions, and rate of development under near-optimal and under competitive conditions). No single genotype is best for all six fitness parameters; rather, genotypes with superior performance during a certain stage of the life-cycle may have low fitness at some other stage, or in different environmental conditions. Heterozygotes are sometimes best when all fitness parameters are considered. There are significant interactions between loci. The various forms of balancing selection uncovered in our experiments may account for the polymorphisms occurring in natural populations of D. pseudoobscura at the three loci studied. (auth)

9455 Mapping and gene conversion studies with the structural gene for iso-1-cytochrome C in yeast. Lawrence, C.W.; Sherman, F.; Jackson, M.; Gilmore, R.A. (Univ. of Rochester, NY). *Genetics;* **81**: No. 4, 615-629(Dec 1975).

We have investigated the order of the four genes cycl, rad7, SUP4, and cdc8 which form a tightly linked cluster on the right arm of chromosome X in the yeast Saccharomyces cerevisiae. Crossing over and coconversion data from tetrad analysis established the gene order to be centromere—cyc1—rad7—SUP4. Also cdc8 appeared to be distal to SUP4 on the basis of crossovers that were associated with conversion of SUP4. The frequencies of recombination and the occurrence of coconversions suggest that these four genes are contiguous or at least nearly so. Gene-conversion frequencies for several cyc1 alleles were studied, including cyc1—1, a deletion of the whole gene that extends into the rad7 locus. The cyc1—1 deletion was found to be capable of conversion, though at a frequency some fivefold less than the other alleles studied, and both 3:1 and 1:3 events were detected. In general 1:3 and 3:1 conversion events were equally frequent at all loci studied, and approximately 50% of conversions were accompanied by reciprocal recombination for flanking markers. The orientation of the cyc1 gene could not be clearly deduced from the behavior of the distal marker SUP4 in wild-type recombinants that arose from diploids heteroallelic for cyc1 mutations. (auth)

9456 Genetic change and rates of cladogenesis. Avise, J.C.; Ayala, F.J. (Univ. of California, Davis). *Genetics;* **81**: No. 4, 757-773(Dec 1975).

Models are introduced which predict ratios of mean levels of genetic divergence in species-rich versus species-poor phylads under two competing assumptions: (1) genetic differentiation is a function of time, unrelated to the number of cladogenetic events and (2) genetic differentiation is proportional to the number of speciation events in the group. The models are simple, general, and biologically real, but not precise. They lead to qualitatively distinct predictions about levels of genetic divergence depending upon the relationship between rates of speciation and amount of genetic change. When genetic distance between species is a func-

tion of time, mean genetic distances in speciose and depauperate phylads of equal evolutionary age are very similar. On the contrary, when genetic distance is a function of the number of speciations in the history of a phylad, the ratio of mean genetic distances separating species in speciose versus depauperate phylads is greater than one, and increases rapidly as the frequency of speciations in one group relative to the other increases. The models may be tested with data from natural populations to assess (1) possible correlations between rates of anagenesis and cladogenesis and (2) the amount of genetic differentiation accompanying the speciation process. The data collected in electrophoretic surveys and other kinds of studies can be used to test the predictions of the models. For this purpose genetic distances need to be measured in speciose and depauperate phylads of equal evolutionary age. The limited information presently available agrees better with the model predicting that genetic change is primarily a function of time, and is not correlated with rates of speciation. Further testing of the models is, however, required before firm conclusions can be drawn. (auth)

TRACER TECHNIQUES

9457 DNA fiber replication in chromosomes of a higher plant (Pisum sativum). Van't Hof, J. (Brookhaven National Lab., Upton, NY). *Exp. Cell Res.*; **93**: 95-104(1975).

Techniques were developed for the autoradiographic analysis of chromosomal DNA fiber replication of higher plant cells. The DNA fibers of Pisum root meristem cells replicate via many tandemly arranged replicons. Each replicon has an initiation point and the average distance between them is about 54 μm. Most of the replicons of Pisum showed bidirectional DNA chain growth that proceeded from a commonly shared initiation point. The average rate of replication per single fork is approx. 29 μm/h at 23°C. (auth)

METABOLISM

REFER ALSO TO CITATION(S) 9424, 9425

9458 Dietary zinc intake in man. Osis, D. (Veterans Administration Hospital, Hines, IL); Kramer, L.; Wiatrowski, E.; Spencer, H. *Am. J. Clin. Nutr.*; **25**: 582-588(Jun 1972).

The daily dietary zinc intake, as well as the amounts of zinc contained in individual meals, was determined in constant metabolic diets and in hospital diets. The total zinc content in nine hospital diets was found to vary by more than a factor of 2, ranging from 7.0 to 16.3 mg zinc/day and averaging 11.3 mg zinc. The variability of the zinc content of these diets was due to differences in their composition, depending on the protein and carbohydrate content of the meals. A total of 138 constant metabolic diets was analyzed for zinc over a 4-year period. The zinc content of these diets varied little, ranging from 11.6 to 12.7 mg/day in each of the 4 years and averaging 12.2 mg. The analysis of diets of low and high protein content, as well as the analysis of single food items, indicated that the foods and diets high in protein were also high in zinc, whereas those foods and diets containing mostly carbohydrate, were found to be much lower in zinc and nitrogen content. (auth)

9459 Induction of squamous metaplasia (vitamin A deficiency) and hypersecretory activity in tracheal organ cultures. Marchok, A.C.; Cone, M.V.; Nettesheim, P. (Oak Ridge National Lab., TN). *Lab. Invest.*; **33**: No. 4, 451-460(1975).

Maintenance of rat tracheal organ cultures in various nutritional environments was studied. In Waymouth's 752/1 defined, vitamin A-free medium the mucociliary epithelium, at the site of the original mucosa, changed to a highly active keratinizing squamous epithelium. Epithelial cells that migrated from the original mucosa covered the underside of the tracheal explants developed into keratinizing squamous epithelium within a few days. These transitions were accompanied by high rates of DNA synthesis as revealed by ^{3}H-thymidine incorporation into the explants. Addition of 10 percent horse serum to the Waymouth's medium completely inhibited squamous metaplasia. In this medium, the actively secreting mucociliary epithelium of the original mucosa slowly became quiescent, and the undergrowth epithelium usually remained undifferentiated. These explants maintained a lower level of DNA synthesis. When vitamin A (all trans retinol) was added to the serum-supplemented medium, 0.2 and 2.0 μg. per ml. induced hypersecretory activity in the original mucosa. Addition of 2.0 μg. per ml. also stimulated cellular hyperplasia and mitoses. A concentration of 20 μg. of vitamin A per milliliter of medium was toxic. It is concluded that a spectrum of epithelial cell types normally found in the tracheal mucosa in vivo can be induced and maintained in tracheal organ cultures in vitro by selection of the appropriate nutritional environment. (auth)

9460 Seasonal respiration rates of yellow-poplar roots by diameter classes. Cox, T.L. (South Dakata State Univ., Brookings). *For. Sci.*; **21**: No. 2, 185-188(Jun 1975).

Root respiration rates (μl CO_2/g dry wt/hr) of four diameter classes (>1.0, 1.0—0.5, 0.5—0.1, and <0.1 cm) of Liriodendron tulipifera roots were determined for winter and early summer in a differential respirometer. Respiration rates were influenced by root diameter, season, and temperature. At both time periods significant correlations ($r^2 = 0.99$) between diameter and CO_2 production were observed. Respiration rates increased directly with temperature ($Q_{10} = 2.7$). When measured at the same temperature, roots removed from actively growing trees (June 1972) respired at rates 1.4 to 8 times that of similar diameter roots during winter dormancy (late November). Larger roots (>0.5 cm classes) exhibited the greatest increases in respiration. (auth)

9461 Annulus formation and growth of tigerfish, Hydrocynus vittatus, in Lake Bangweulu, Zambia. Griffith, J.S. (Department of Fisheries, Samfya, Zambia). *Trans. Am. Fish. Soc.*; **104**: No. 3, 499-505(Jul 1975).

The validity of scale analysis for aging tigerfish, Hydrocynus vittatus Castelnau, was assessed by examining the timing and cause of check formation on scales from fish collected in Lake Bangweulu, Zambia. Discontinuities in circuli that appeared to be valid annuli formed on all scales in September when water temperature was rising rapidly after dropping to 18 C. Spawning checks formed on scales of some fish in January. Male and female tigerfish grew at similar rates. Some females reached an age of 11 years but male tigerfish, which matured one and sometimes two years earlier, seldom lived longer than 4 years. (auth)

9462 Persistent alteration of pituitary—adrenal function in the rat by prepuberal corticosterone treatment. Turner, B.B.; Taylor, A.N. (Univ. of California, Los Angeles). *Endocrinology*; **98**: No. 1, 1-9(Jan 1976).

The possible existence of periods of sensitivity to elevated levels of corticosterone in the postnatal development of the pituitary-adrenal axis was investigated. Long-Evans rats were implanted ip with corticosterone (25 mg/100 g body wt) mixed with an equal amount of cholesterol on postnatal days 3, 6, 12 or 18. Eight blood samples were obtained from each animal at various ages by cardiac puncture. Steroid treatment during the first postnatal week resulted in lowered adult basal levels of plasma corticosterone without affecting the diurnal rhythm. Males treated on day 3 had lowered peak (PM) and trough (AM) levels of the steroid as adults, while males treated on day 6 showed only a lowered PM level. A similar reduction in basal levels of plasma corticosterone was observed in immature females, but did not persist into adulthood. Steroid treatment at day 12 had no effect on basal or diurnal pituitary-adrenal activity. Treatment at day 18 reduced the amplitude of the adult diurnal rhythm in both sexes and delayed the onset of the rhythm in males. No differences in stress responsiveness or adrenal weights were detected. Thus, two distinct periods exist in the postnatal development of the rat during which basal and diurnal pituitary-adrenal activity can be differentially and persistently altered by treatment with the naturally occurring glucocorticoid. (auth)

TRACER TECHNIQUES

9463 (COO—1231-104) Metabolism of ^{90}Sr and of other elements in man, July 1, 1974—June 30, 1975. (Veterans Administration Hospital, Hines, Ill. (USA)). 31 Dec 1975. Contract AT(11-1)-1231. 28p. Dep. NTIS $4.00.

Trace element studies have been carried out under strictly controlled dietary conditions in adult males during different calcium intakes. Complete metabolic balances of cadmium, copper, zinc, lead, manganese, and nickel were determined in each 6-day metabolic period by analyzing the constant diet and the urinary and fecal excretions of these naturally occurring elements. In addition to the trace element studies, ^{85}Sr studies were carried out in man in order to complete previously initiated investigations. (auth)

9464 Modification of glycerolipid metabolism in L-M fibroblasts by an unnatural amino-alcohol, N-isopropylethanolamine. Blank, M.L.; Piantadosi, C.; Ishaq, K.S.; Snyder, F. (Oak Ridge Associated Universities, TN). *Biochem. Biophys. Res. Commun.*; **62**: No. 4, 983-988(17 Feb 1975).

The unnatural amino-alcohol, N-isopropylethanolamine, is incorporated into a phospholipid by monolayers of L-M fibroblasts. This phospholipid was identified as 1, 2-diacyl-sn-glycero-3-phosphoisopropylethanolamine by using chemical and enzymatic procedures combined with thin-layer and gas-liquid chromatography. Since the phospho-N-isopropylethanolamine moiety is removed by phospholipase C, the stereochemistry of the phospholipid analog is identical to naturally occurring phosphoglycerides. Incubation of cells in 10 mM N-

isopropylethanolamine inhibited the incorporation of [^{14}C]choline and ^{14}C]ethanolamine into phospholipids and stimulated the incorporation of [1-^{14}C]palmitic acid and [1-^{14}C]hexadecanol into triacylglycerols and alkyldiacylglycerols. These results indicate that N-isopropylethanolamine affects glycerolipid synthesis at the diradylglycerol branch point. (auth)

MEDICINE

REFER ALSO TO CITATION(S) 8345, 9356, 9435, 9484, 9485

9465 Kinetics of hemolytic plaque formation. IV. IgM plaque inhibition. DeLisi, C. (Los Alamos Scientific Lab., NM). *J. Theor. Biol.*; **52**: 419-440(1975).

An analysis of the inhibition of hemolytic plaques formed against IgM antibodies is presented. The starting point is the equations of DeLisi and Bell (1974) which describe the kinetics of plaque growth, and DeLisi and Goldstein (1975) which describe inhibition of IgG plaques. However, the physical chemical models which were used previously to describe IgG inhibition data are shown to be inadequate for describing the characteristics of IgM inhibition curves. Moreover, it is shown that the experimental results place severe restrictions on the possible choices of physical chemical models for IgM upon which to base the calculations. It is argued that in order to account even qualitatively for all the data, one must assume (1) a very restricted motion of IgMs about the Fab hinge region and (2) a very narrow secretion rate distribution of IgM by antibody secreting cells. (auth)

9466 Coagulation-time determination with automatic multivariable analysis, by use of a miniature centrifugal fast analyzer. Bostick, W.D.; Bauer, M.L.; Morton, J.M.; Burtis, C.A. (Oak Ridge National Lab., TN). *Clin. Chem.*; **21**: No. 9, 1288-1293(Aug 1975).

From 7. annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975).

See CONF-750319—.

Use of a miniature Centrifugal Fast Analyzer for the parallel photometric monitoring of the coagulation process is shown to have a number of advantages. These include a choice of optical modes, virtually simultaneous initiation and observation of the coagulation process for a number of patient-plasma samples and an on-board control sample, small sample and reagent volume requirements, and automatic determination of a number of diagnostically useful variables (including relative fibrinogen content) from the data recorded in a single run. Also, the system is shown to give results that correlate well with those obtained by conventional techniques for determination of prothrombin time. (auth)

9467 Correlation of radial bone mineral content with total body calcium in chronic renal failure. Cohn, S.H.; Ellis, K.J.; Casselnova, R.C.; Asad, S.N.; Letteri, J.M. (Brookhaven National Lab., Upton, NY). *J. Lab. Clin. Med.*; **86**: No. 6, 910-919(Dec 1975).

Loss of bone mineral of the skeleton in renal disease can be measured directly by total body neutron activation analysis (TBNAA), and also by an absorptiometric technique applied to the appendicular skeleton (radius). In the present study the results of these two techniques are compared in 25 patients with renal insufficiency, 53 patients with end-stage renal failure on dialysis, and 24 normal control subjects. It is apparent that there is good correlation between total body calcium (TBCa) and bone mineral content (BMC) in all groups studied. The correlation in the normal contrast group was 0.944 as compared to 0.919 for the renal patients and 0.892 for patients with end-stage renal failure on dialysis. In order to measure the relative deficit in TBCa in individual patients from the absolute Ca measurement, it is necessary to normalize the data for sex, age, and skeletal size. For this purpose, an empirically derived relationship was used to predict the normal skeletal Ca in each subject, based on weight, height, sex, and age. The measured TBCa divided by the predicted TBCa is referred to as the calcium ratio. This ratio is useful in expressing the relative deficit of Ca in individual renal patients. In similar manner, BMC data were normalized, with the same relationship used to obtain BMC ratios. The normalization procedures allow both the TBCa and BMC measurements to be used to quantitate the Ca deficit in individual patients with renal insufficiency. (auth)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 9314, 9533

9468 (CONF-750124—, pp 77-88) **Computer-assisted computation of infarct size in experimental animals using /sup 99m/technetium phosphate scintigrams.** Stokely, E.M.; Lewis, S.E.; Buja, L.M.; Parkey, R.W.; Bonte, F.J.; Willerson, J.T. (Univ. of Texas Health Science Center, Dallas). 1975.

From 5. symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In Proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine.

Three methods were investigated for predicting myocardial infarction size. /sup 99m/Tc stannous pyrophosphate scintigrams were obtained in six mongrel dogs 48 hours after coronary occlusion produced by ligating the left anterior descending coronary artery. Computer-aided processing of the images was used to calculate infarct projected area utilizing image processing and a Golay transform algorithm for detecting boundaries. The results suggest that infarct areas measured from anterior and left anterior oblique scintigrams can be used to calculate infarct weight using a linear relationship between scintigram infarct area and morphological infarct weight. Linear regression methods were used to determine the best linear relationship between the two sets of data. (auth)

9469 (LBL—3872) **Axial tomography and three dimensional image reconstruction.** Chang, L.T.; Macdonald, B.; Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 8p. (CONF-751116—20). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A number of existing γ cameras for imaging of radioisotope distributions give depth information about the distribution. These devices have in common that they provide tomographic images of the object, that is, that images of a given object plane have that plane in focus and all other object planes contribute an out-of-focus background superimposed on the in-focus image. A method is described for three dimensional reconstruction of these axial tomographic images which removes the blurred off-plane activity from a number of transverse planes simultaneously. The method is applicable to a number of tomographic cameras, such as the multiple single-pinhole camera, the rotating slanted-hole collimator, the Anger focussing tomographic scanner, and the positron camera. The method can be implemented on a small computer having a disc system. (auth)

9470 (TID—26975) **Biological effects of radiation and related biochemical and physical studies, November 1, 1974—September 30, 1975.** (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 1975. Contract E(11-1)-3521. 140p. (COO—3521-166; COO—3521-167; COO—3521-168). Dep. NTIS $7.00.

Separate abstracts were prepared for the three sections of this progress report. (SFL)

9471 (TID—26975, pp vp, Paper 1) **Production of radionuclides, labeled compounds and fast neutron beams.** Laughlin, J.S.; Tilbury, R.S.; Kuo, T.Y.T.; Gelbard, A.S. 1975.

In Biological effects of radiation and related biochemical and physical studies, November 1, 1974—September 30, 1975.

Progress is reported on the cyclotron-production of short-lived radioisotopes for use in clinical diagnostic studies. Radiopharmaceuticals labeled with ^{18}F, ^{11}C, ^{13}N, and ^{75}Se were tested for use in scanning bone tissues, the brain, and mammary glands for the localization of neoplasms and ^{14}O was used in metabolic studies. (CH)

9472 (TID—26975, pp vp, Paper 3) **Metabolic studies in cancer with radioactive isotopes.** Laughlin, J.S.; Myers, W.P.L. 1975.

In Biological effects of radiation and related biochemical and physical studies, November 1, 1974—September 30, 1975.

Progress is reported on the use of cyclotron-produced radioisotopes for use in clinical diagnostic studies. Radiopharmaceuticals labeled with ^{15}O, ^{11}C, ^{206}Bi, ^{111}In, ^{67}Ga, or ^{37}Ar were tested for the localization of neoplasms, ^{13}N was tested for use in metabolic studies, and ^{52}Fe was tested for use as a tracer for the diagnosis of hemic and skeletal diseases. (CH)

MICROBIOLOGY

REFER ALSO TO CITATION(S) 9429, 9453

9473 (ERDA-tr—113) **Apparatus for testing biochemical reactions on bacteria.** Siegert, R. 16 Feb 1965. Translation of German Patent No. 1,220,083. 5p. Dep. NTIS $3.50.

The apparatus for testing biochemical reactions according to the invention consists of at least one, preferably of a great many chambers, whereby each chamber is composed of a number of sec-

tional chambers located along a common center line. The sectional chambers or partition walls between the sectional chambers are arranged and constructed such that, in the case of pivoting of the chamber around an axis perpendicular to the center line of the sectional chambers, the content of the uppermost chamber immediately flows int the neighboring one. The content of the latter chamber then flows together with that of the first named chamber into the next following one, and so forth. Such an apparatus allows the bacterial culture placed in the first sectional chamber together with a substrate solution, e.g., a sugar solution with phosphate buffer, to be mixed one after another with different reagents which have been kept apart and indeed in a sequence as desired and, in this way, carrying out the actually desired test in the shortest possible time. The invention also allows an extensive automation of testing. (WHK)

9474 Effect of lipid alkyl chain perturbations on the assembly of bacteriophage PM2. Cupp, J.; Klymkowski, M.; Sands, J.; Keith, A.; Snipes, W. (Pennsylvania State Univ., University Park). *Biochim. Biophys. Acta;* **389**: 345-357(1975).

The lipid-containing bacteriophage PM2 can produce infectious virus in cultures infected at temperatures up to 31.5°C, but not at 34°C. Its host, Pseudomonas BAL-31, grows at 34°C and cultures infected at that temperature undergo lysis. Sucrose-gradient analysis shows that 34°C lysates contain no PM2-like particles. Temperature-shift experiments establish that the thermally sensitive process is late in infection when virus assembly is taking place. Adamantanone, a small hydrophobic molecule that perturbs membrane hydrocarbon zones, prevents the production of infective virus. Concentrations which prevent virus production have no effect on host-cell growth or stability of mature virions. Adamantanone exerts its effects late in the infectious cycle, and lysates made in its presence contain no PM2-like particles. These experiments, carried out at 25°C, indicate that adamantanone prevents the assembly of stable PM2 virus. Spin-label studies suggest that the lipid alkyl chains of the host-cell membrane are in an "ordered" state at temperatures below about 33°C and undergo a transition to a "disordered" state above that temperature. Furthermore, the addition of adamantanone perturbs the hydrocarbon zones, producing a greater degree of disorder even below 25°C. Our findings suggest that the cell membrane can function and grow with the lipid alkyl chains in either the "ordered" or "disordered" state, but that the "ordered" state must be maintained for PM2 assembly to occur. (auth)

9475 Butylated hydroxytoluene inactivates lipid-containing viruses. Snipes, W.; Person, S.; Keith, A.; Cupp, J. (Pennsylvania State Univ., University Park). *Science;* **187**: 64-66(4 Apr 1975).

Butylated hydroxytoluene (BHT) is widely used as a food preservative for its antioxidizing property. This small, hydrophobic molecule has been found to be a potent inactivator of lipid-containing mammalian and bacterial viruses. (auth)

9476 Single-stranded regions in transforming deoxyribonucleic acid after uptake by competent Haemophilus influenzae. Sedgwick, B.; Setlow, J.K. (Brookhaven National Lab., Upton, NY). *J. Bacteriol.;* **125**: No. 2, 588-594(Feb 1976).

About 15% of donor deoxyribonucleic acid (DNA) is single stranded immediately after uptake into competent Haemophilus influenzae wild-type cells, as judged by its sensitivity to S1 endonuclease. This amount decreases to 4 to 5% by 30 min after uptake. Mutants which are defective in the covalent association of recipient and donor DNA form little or no S1 endonuclease-sensitive donor. At 17 C donor DNA taken up by the wild type contains single-stranded regions although there is no observable association, either covalent or noncovalent. The single-stranded regions are at the ends of donor DNA molecules, as judged by the unchanged sedimentation velocity after S1 endonuclease digestion. The amount of single-stranded donor remains constant at 17 C for more than 60 min after uptake, suggesting that the decrease observed at 37 C is the result of association of single-stranded ends with single-stranded regions of recipient cell DNA. Three sequential steps necessary for the integration of donor DNA into recipient DNA are proposed: the synthesis of single-stranded regions in recipient DNA, the interaction of donor DNA with recipient DNA resulting in the production of single-stranded ends on donor DNA, and the stable pairing of homologous single-stranded regions. (auth)

9477 Lethal effect of mitomycin C on Haemophilus influenzae. Small, G.D.; Setlow, J.K.; Kooistra, J.; Shapanka, R. (Brookhaven National Lab., Upton, NY). *J. Bacteriol.;* **125**: No. 2, 643-654(Feb 1976).

The sensitivity of ultraviolet-sensitive strains to inactivation by mitomycin C (MC) is at the most only a factor of two greater than that of the wild type. The presence of inducible prophage has very little effect on the sensitivity. Genes which control excision of ultraviolet-induced pyrimidine dimers also control repair of MC-induced cross-links, as measured by resistance of denatured deoxyribonucleic acid (DNA) from treated cells to S1 nuclease digestion. However, endonucleolytic breaks in MC-damaged DNA, as judged by decreased single-strand molecular weight upon incubation of treated cells, are independent of these genes and probably are caused by monoadducts. After long periods of incubation there is a return to the molecular weight of untreated DNA. DNA degradation after MC treatment of various strains is not correlated with sensitivity to inactivation. Stationary-phase cells of all strains are more than twice as sensitive to MC as exponentially growing cells, and the sensitivity difference agrees with the measured difference in the number of cross-links after MC treatment of cells in the two growth stages. Evidence has been obtained that these phenomena result from differences in uptake of MC, which can be influenced by cyclic adenosine monophosphate. Small deviations in MC sensitivity from that of the wild type observed in mutants lacking the adenosine 5′-triphosphate-dependent nuclease are postulated to result from differences in MC uptake. These mutants, although no more ultraviolet sensitive than the wild type, are more sensitive to streptomycin, which also must be taken up by the cell to be effective. (auth)

MORPHOLOGY

9478 Large-scale isolation of intact vacuoles and isolation of chloroplasts from protoplasts of mature plant tissues. Wagner, G.J.; Siegelman, H.W. (Brookhaven National Lab., Upton, NY). *Science;* **190**: No. 4221, 1298-1299(26 Dec 1975).

Intact plant vacuoles were prepared in large numbers (10^6) from protoplasts of mature leaves, flower petals, stems, pedicels, filaments, styles, and young fruits. Treatment of protoplasts with 0.2 molar K_2HPO_4-HCl, pH 8, with slow stirring resulted in gentle osmotic rupture of the protoplasts and release of intact vacuoles. Particulate components of the protoplast, less the vacuole, were largely shed as an aggregate, which was removed by filtration. Vacuoles were recovered from the filtrate by low-speed centrifugation. The general procedure was also used to isolate chloroplasts with a high degree of integrity and excellent photochemical activity. (auth)

PATHOLOGY

REFER ALSO TO CITATION(S) 9435

9479 (LF-tr—114) **Pulmonary ultrastructural aspects of oxygen poisoning under atmospheric pressure in the rat.** Pariente, R.; Legrand, M.; Brouet, G. Translated from *Presse Med.;* **77**: 1073-1076(1969). 13p. Dep. NTIS $3.50.

Oxygen poisoning was studied in rats. Therapeutic methods using hyperbaric oxygen therapy have made it possible to discover the disadvantages of oxygen, whether it be administered at high pressures of several atmospheres or even given in a pure state at atmospheric pressure. Results are reported from studies of ultrastructural changes in the lungs, observed under the electron microscope, observed in relation to the proportion of oxygen in the air beyond which toxicity occurred, and the time elapsing until that toxicity was manifested.

9480 (LF-tr—107) **Pathological changes in scleroderma.** Sera, K. Translated from *Nihon Kyobu Shikkan Gakkai Zasshi;* **10**: 69(1972). 3p. Dep. NTIS $3.50.

Methods for the measurement of lung changes in patients with diffuse collagen disease are reviewed. (CH)

9481 (LF-tr—106) **Relationship between locations of pulmonary and vascular lesions in collagen disease.** Shigematsu, N. Translated from *Nihon Kyobu Shikkan Gakkai Zasshi;* **10**: 69-70(1972). 5p. Dep. NTIS $3.50.

Among many diseases causing diffuse fibrosis of the lung, collagen disease is the most representative of interstitial pulmonary fibrosis, but it is often difficult to distinguish this disease from other diseases, even with various clinical test results. Results are reported from studies on the site of occurrence of pathological changes of blood vessels in the lung in these diseases. (auth)

9482 Hydroxyurea effects in the C3H mouse. II. Mammary tumor cell kinetics. Dethlefsen, L.A.; Riley, R.M. (Univ. of Utah, Salt Lake City). *Cell Tissue Kinet.;* **6**: 173-184(1973).

The cellular kinetics of C3H mouse mammary tumors were studied following a single dose (3 mg/g body weight) of hydroxyurea (HU). This dose was large enough to cause a significant perturbation in the growth curves of these tumours. This was accom-

plished by labeling the cells with tritiated 5-iodo-2'-deoxyuridine and performing detailed autoradiographic analysis. This dose of HU caused a temporary inhibition in growth and completely inhibited DNA synthesis for 4—5 hr. The HU-killed cells (pyknotic and karyorrhectic) reach a maximum around 10—12 hr and are apparently all removed in about 1 day. Tumors from a fast-growing line (S102F) showed some evidence for cell synchrony upon recovery from HU inhibition but desynchronization occurred within one cell cycle. The cell generation time was not decreased during the acute recovery phase, but the growth fraction shifted from 0.6 to 1.0, and the data suggested that the normal flow of cells from the proliferating pool to the degenerate pool was temporarily interrupted. The cellular kinetic parameters have probably returned to normal by 48 hr after the HU injection. (auth)

9483 (LF-tr—119) **Pulmonary function disorders in fibrosis.** Arzt, G.H. Translated from *Internist;* **15**: 364-369(1974). 18p. Dep. NTIS $3.50.

Pulmonary fibrosis can be the final result of very different pathological processes. It is accompanied by structural fibrosis, which represents either a disease limited to the lung or a partial sign of a generalized disease of the connective tissue. The pathological modifications of the pulmonary structure at a number of subthreshold irritations, in the final stages of a long disease process which progresses to alveolar fibrosis, consist of a reinforcement and reconstruction of the interstitial pulmonary structure. The elasticity of the lungs is thereby limited and there can also be a thickening of the alveolar membrane, that is, of the surface of contact between the media of air and blood. The modifications lead functionally to the picture of classical obstructive respiratory disorders, to impairment of gas exchange between the alveoli and capillaries, to a diffusion disorder caused by mechanical impairment of gas exchange, and to a perfusion disorder caused by reduction of the alveolar capillary network as a result of intraalveolar, perialveolar, and interalveolar changes. (auth)

9484 **Carcinogenicity of methylated nitrosopiperidines.** Lijinsky, W.; Taylor, H.W. (Oak Ridge National Lab., TN). *Int. J. Cancer;* **16**: 318-322(1975).

The carcinogenicity of nitrosopiperidine and five methylated derivatives was compared by feeding them to rats at equimolar concentrations in drinking water, at the rate of 20 ml per day, 5 days a week. The maximum treatment time was 50 weeks. Nitrosopiperidine, 2-methyl, 3-ethyl- and 4-methylnitrosopiperidine induced tumors of the nasal turbinates or upper gastrointestinal tract in almost 100% of the animals. There was a significantly longer time to death from these tumors in the group treated with 2-methylnitrosopiperidine and a number of hepatocellular carcinomas appeared in this longer lived group. Very few tumors of these sites were seen in rats treated with 2,6-dimethyl- or 2,2,6,6-tetramethyl-nitrosopiperidine. It was concluded that blockage by methyl groups of one or more carbon atoms alpha to the nitroso function in nitrosopiperidine significantly reduces carcinogenic activity of the molecule. (auth)

9485 **Increased carcinogenicity of 2,6-dimethylnitrosomorpholine compared with nitrosomorpholine in rats.** Lijinsky, W.; Taylor, H.W. (Oak Ridge National Lab., TN). *Cancer Res.;* **35**: 2123-2125(Aug 1975).

Nitrosomorpholine was given to rats in drinking water at the rate of 4 mg/week for 30 weeks. Tumors of the liver were induced in 53% of treated animals and were of both hepatocellular and Kupffer cell origin. One-half of the treated animals were alive 75 weeks after the beginning of treatment, but only 2 survived to 104 weeks. 2,6-Dimethylnitrosomorpholine was given to rats at the same molar concentration in drinking water for 30 weeks (5 mg/week). All of these animals died with tumors within 34 weeks after the beginning of treatment; these tumors were mainly in the esophagus and nasal turbinates, and only 1 liver tumor was seen. This greatly changed tumorigenicity of the dimethyl compound might be due to steric factors or to enhanced reactivity at the positions α to the nitroso function induced by the methyl groups at the β position. (auth)

9486 **Carcinogenicity of N-nitroso-3,4-dichloro- and N-nitroso-3,4-dibromopiperidine in rats.** Lijinsky, W.; Taylor, H.W. (Oak Ridge National Lab., TN). *Cancer Res.;* **35**: 3209-3211(Nov 1975).

The carcinogenic potencies of 3,4-dichloro- and 3,4-dibromonitrosopiperidine were compared with that of nitrosopiperidine by feeding to groups of 15 male rats in drinking water. A treatment of 15 weeks with a total of 0.5 mmole of the dichloro compound led to death of all animals before 24 weeks with tumors of the tongue, pharynx, esophagus, nonglandular stomach, nasal turbinates, trachea, bronchi, and bronchioles. Treatment of 27 weeks with the dibromo compound, a total of 1.0 mmole, caused death of all the animals by 41 weeks, with the same types of tumors. One-half of the rats treated with an almost 3-fold higher daily dose of nitrosopiperidine, 3.9 mmoles total, were alive at 40 weeks, and all were not dead until 55 weeks. Most of these animals died with tumors of the tongue, pharynx, esophagus, and nonglandular stomach and with squamous cell tumors and olfactory carcinomas of the nasal cavity, but there were no tumors of the respiratory tree. Substitution of chlorine or bromine in nitrosopiperidine greatly increased the carcinogenicity of the compound. (auth)

TRACER TECHNIQUES

9487 (LF-tr—115) **Experimental study of the pulmonary retention of metallic particles. Application to tantalum bronchography.** Masse, R.; Ducousso, R.; Nolibe, D.; Lafuma, J.; Chretien, J. Translated from *Rev. Fr. Mal. Respir.;* **1**: 1063-1075(1973). 16p. Dep. NTIS $3.50.

After tracheal insufflation of tantalum powder and iron oxide, many retention mechanisms become apparent in the rat and monkey. The respiratory bronchiole of the rat and the membranous bronchus of the monkey are the site of prolonged retention. Many pathological alterations are observed at their level: signs of granulomatous and adenomatous formation in the rat, alteration of the bronchial lining, bronchiolization of the peribronchial alveoli; and inclusion of these alveoli in the peribronchial sheath in the monkey. Only the cat is capable of clearing these particles promptly and completely. The prolonged retention of the particles and the lesions that they cause constitute a contraindication to bronchography by tantalum insufflation in man. (auth)

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 9350, 9465

9488 (CRSSA—1973, pp 49-51) **Effects of imolamine on oxydophosphorylation mechanisms of rat hepatic mitochondria in vivo and in vitro. Possible inhibition radioactive strontium collection.** Tine, J.; Godart, P.; Rocquet, G. [nd]. (In French).

In Centre de Recherches du Service de Sante des Armees. 1973 scientific works.

The effect of coronary vasodilatator agent on oxydophosphorylation mechanisms and on Ca^{2+} collection of rat hepatic mitochondria in vivo and in vitro is described. (FR)

9489 (LA-UR—76-228) **Some mathematical models in immunology, I.** Bell, G.I. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 24p. (CONF-760217—1). Dep. NTIS $3.50.

From Annual meeting of American association for the advancement of science; Boston, Massachusetts, United States of America "USA" (24 Feb 1976).

The physiology of the mammalian immune system is reviewed with emphasis on the clonal selection theory. Applications of mathematical analysis to quantitative techniques for measuring immune responses are discussed. (CH)

9490 (ORO—3792-17) **Developmental approach to the study of immunologic tolerance. Effect of tolerant thymocytes on in vitro response of sensitized spleen cells to antigen. Progress report, May 1, 1975—April 30, 1976.** Hyde, R.M. (Oklahoma Univ., Oklahoma City (USA). Dept. of Microbiology and Immunology). 1976. Contract AT(40-1)-3792. 17p. Dep. NTIS $3.50.

In vitro blastogenesis was utilized as a parameter of immune responsiveness. It was reasoned that if suppressor T cells played a part in immune unresponsiveness to HGG, thymocytes that had been exposed to sHGG in vivo for 24 hrs might well suppress immune blastogenesis to HGG by sensitized splenocytes in vitro. In preliminary experiments the sensitized splenocytes were found to require 4 days of culture for optimal response. Thymocytes from animals treated with tolerogen 24 hrs previously appear to suppress an in vitro blastogenic response. In all three experimental situations, there was a small but significant difference between the group receiving 2×10^5 sensitized thymocytes and the group receiving 2×10^5 tolerant thymocytes. (auth)

9491 (UCD—472-122, pp 40-43) **Bone mineral in the developing beagle: in vivo analysis.** Fisher, G.; Berding, K. Jun 1975.

In Annual report, fiscal year 1975.

The photon absorptiometer was used to measure ash weight: bone width ratio at three sites along the radius-ulna of beagles from 86 to 268 days of age. Optimal scan sites were selected after evaluating the results of preliminary scanning of two developing male beagles over a three-month interval. Data were fitted to one of four regression models: linear, parabolic, exponential, and

power function. Regression equations and curves are shown for ash weight: bone width ratios. (HLW)

9492 (UCD—472-122, pp 74-76) **Enumeration of canine blood platelets.** Munn, S.; Shimizu, J.; Gee, W. Jun 1975.

In Annual report, fiscal year 1975.

Platelets were counted by visual methods, by electronic counting with the Coulter Counter Model B, and by use of the autocounter, an automatic optical counting system. Comparative studies demonstrated that the autocounter produced reliable beagle platelet counts. (HLW)

9493 (UCD—472-122, pp 139-140) **In vitro testing for transfer factor.** Shifrine, M.; Beards, R.; Thilsted, J.; Taylor, N.J. Jun 1975.

In Annual report, fiscal year 1975.

Transfer factor (TF) was prepared from various lymphoid organs and peripheral blood of BCG-vaccinated dogs and tested the preparations in vitro using the lymphocyte stimulation test (LST). Lymphocytes from a normal (PPD-negative) dog were cultured in a microplate with transfer factor and PPD. Additional cultures included lymphocytes with TF only and those without TF but containing either PPD or PHA. All cultures were compared with one containing normal lymphocytes with TF and normal lymphocytes with PPD. (auth)

9494 (UCD—472-122, pp 146-147) **Studies on the lymphocyte stimulation test in the dog.** Thilsted, J.; Shifrine, M. Jun 1975.

In Annual report, fiscal year 1975.

Studies were conducted to develop a sensitive and reproducible test for the determination of immunocompetence and for the detection of antigen-specific cell-mediated immunity. Dose-response curves for two antigens and for PHA were completed in order to find the concentrations that give maximal stimulation. Graphs are presented to show results. (HLW)

9495 (UCD—472-122, pp 148-154) **Development of models for the in vivo and in vitro study of dysplasia and neoplasia in the canine mammary gland.** Chrisp, C.; Galligan, J.; Lammert, J. Jun 1975.

In Annual report, fiscal year 1975.

An in vivo transplantation model and an in vitro organ culture system have been developed for the study of canine mammary dysplasia and neoplasia. Preliminary studies indicate that transplantation of canine mammary nodules to the chorionic epithelium of the chick embryo and explantation to the chick mesonephros in organ culture may be useful additional tools for the study of the pathobiology of these lesions. (auth)

9496 (UCD—472-122, pp 155-156) **Ceruloplasmin levels in sera from human patients with osteosarcoma.** Shifrine, M.; Fisher, G.L.; Neves, J.; Berding, K. Jun 1975.

In Annual report, fiscal year 1975.

Ceruloplasmin (Cp) levels in sera of osteosarcoma patients, women on chemical contraceptives, and normal individuals were determined using radial immunodiffusion (RID) and rocket electroimmunophoresis (REP), and serum copper levels (SCL) were determined by atomic absorption spectroscopy. Results indicated that the ratio of bound to unbound copper in the serum is maintained in both osteosarcoma patients and women receiving chemical contraceptives compared with normal individuals. However, Cp concentrations as well as SCLs in sera from patients with osteosarcoma were significantly elevated over those in sera from normal persons. (HLW)

9497 (UCD—472-122, pp 157-159) **Copper and zinc levels in serum from human patients with sarcomas.** Fisher, G.L.; Byers, V.S.; Shifrine, M.; Levin, A.S. Jun 1975.

In Annual report, fiscal year 1975.

Serum copper levels were elevated in human patients with primary osteosarcoma and metatastatic osteosarcoma, while serum zinc levels were elevated in the primary neoplasm and depressed in the metastatic disease. Thus the ratio of copper to zinc in the serum of patients with osteosarcoma appears to be an indicator of metastasis. (auth)

9498 (UCLA—12-1016) **Roots of higher plants as a barrier to translocation of some metals to shoots of plants.** Wallace, A.; Romney, E.M. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1975. Contract E(04-1)-GEN-12. 14p. (CONF-750985—6). Dep. NTIS $3.50.

From 15. Hanford life sciences symposium; Richland, Washington, USA (25 Sep 1975).

Roots of most, if not all, higher plants are barriers to the translocation of many trace elements to the shoots of plants. Some of the elements in question are not essential insofar as is known to plants and it is possible that no special metabolic mechanism exists for their uptake or translocation. The uptake and translocation of them which is observed may be due either to involvement in mechanisms related to other metals or to passive factors. The high levels of at least some metals in roots may be due to binding on root exchange and/or membrane surfaces and may represent little or no actual uptake into roots. Experimental data have been obtained for distribution in roots, stems, and leaves for Ti, Cr, Sn, Pb, and Cd. All of these, but in differing proportions, were concentrated in roots of plants. Most were toxic, but at varying degrees. Interactions with chelating agents were observed for some of the metals and this was sometimes associated with increased translocation to shoots. Calcium at high levels decreased the effects of excessive levels of at least some of the metals tested. Toxicities of these elements can exist and leaf analysis would usually fail to diagnose the problem because of failure of transport to shoots. Even though high levels did cause toxicity, the mechanism of root retention sometimes serves as a protection factor against toxicity. (auth)

9499 (LF-tr—109) **Problem of the role of Vitamin C in the formation of connective tissue.** Okun, M.I. Translated from *Ukr. Biokhim. Zh.*; No. 1, 66-70(1967). 10p. Dep. NTIS $3.50.

Experimental silicosis, characterized by intense connective tissue neoformation in the lungs was used to study the question of involvement of vitamin C in the synthesis of collagen and hexosamine and in the formation of fibrous tissue. (auth)

9500 (LF-tr—113) **Some characteristics of the composition of the insoluble collagen of rat lung under normal conditions and in experimental silicosis.** Vasil'eva, G.N.; Myagkaya, G.L. Translated from *Vopr. Med. Khim.*; **16**: No. 3, 286-289(1970). 9p. Dep. NTIS $3.50.

The data are presented on study of insoluble collagen obtained from lung tissue of healthy rats and from those with experimental silicosis. The content of some amino acid (hydroxyproline, proline, tyrosine) and carbohydrates (utonic acid and hexoses) in insoluble collagen was determined. It was established that lung collagen of healthy rats as well as those with experimental silicosis does not differ from collagen in other tissues, but has the less proline content as compared to the collagen in other tissues of different animals. The characteristic feature of insoluble lung collagen of rats is the high hexoses content (at average 2.5 percent). Hexoses content in insoluble lung collagen at later periods of silicosis development was diminished. (auth)

9501 (LF-tr—98) **Work session on the physiological effects of air shocks, held at ISL (Institute Saint Louis) on 17 March 1972.** 1972. Translation of ISL—7/72. 98p. Dep. NTIS $5.00.

Results are reported from studies on the biological effects of air shock waves and noise from air booms. Data are included on the effects of impulse noise on the autonomic nervous system and temporary variation of the hearing threshold in comparison with the effects of continuous noise. (CH)

9502 (LF-tr—110) **Oxyproline content in the composition of peptides of the pulmonary tissue of animals with experimental silicosis.** Rodkina, B.S. Translated from *Ukr. Biokhim. Zh.*; **46**: No. 3, 393-397(1974). 10p. Dep. NTIS $3.50.

The content of peptide, protein and free oxyproline was studied in the lungs of intact puberal rats and rats with experimental silicosis. It is established that in a norm in the lungs there is 49.0 +- 5.3 μg of peptid and only 1.4 +- 0.6 μg of free oxyproline per 100 mg of dry tissue on the average. With experimental silicosis which was characterized by rapid development of the connective tissue, both the content and the absolute amount of peptide oxyproline in the lungs are sharply increased. The rate of an increase in the content of peptid oxyproline exceeds considerably that of oxyproline bound with collagen. It results in the fact that the value of the peptide oxyproline and protein ratio which in a norm is equal 3, increases in the "dusted" animals to 6.6. In the animals with heavy silicosis which were administered polyvinylpyridin-N-oxide a regressing of the fibrous process is observed. The process is accompanied by a lowering in the lungs weight, by a considerable decrease in the content of collagen and especially of peptid oxyproline in this organ. A greater part of peptide oxyproline contained in the tissues is supposed to be formed in the process of collagen synthesis. (auth)

9503 (LF-tr—116) **Phospholipid metabolism in alveolar macrophages of lungs (32p)orthophosphate incorporation in pulmonary surfactant in rat in vivo and in vitro.** Soula, G.; Champanet, C. Translated by C. Schnizlein from *Eur. J. Biochem.*; **46**: 491-497(1974). 7p. Dep. NTIS $3.50.

The role of the phospholipids in the normal functioning of the lung was studied in pulmonary alveolar macrophages of rat lung after the incorporation of ^{32}P orthophosphate in vivo and in vitro. (auth)

9504 (LF-tr—105) **Report on the recording with the aid of holographic interferometry by double exposure of the motion of the tympanum of guinea pigs undergoing the action of short-time sound effects.** Smigielski, P.; Albe, F.; Fagot, H.; Dancer, A.; Franke, R. 11 Feb 1974. Translation of ISL—8/74. 29p. Dep. NTIS $4.00.

The paper reports on a holographic set-up used for investigating the deformation over time of the tympanum of guinea pigs subjected to sound effects with intensities ranging from 0.5 to 1 mbar. The positive phase of the sound effect is of the order of 200 μsec and the rise time lies in the microsecond range. The light source used was a single mode Q-switch ruby laser which supplied a coherent light pulse of 100 mJ in 20 nsec. For each experiment, the first exposure of the hologram was made in the absence of the sound effect whereas the second one was made at a given instant after the start of the burst. In the image reconstruction process, a closed-circuit television system allows to observe, under favorable conditions, the interference fringes located close to the tympanum and characterizing the motion of the tympanic membrane. The validity and accuracy of the quantitative results achieved in the analysis of the interferograms are discussed. The strongest motion of the tympanum is found to be located in a crescent-shaped zone opened upwards and enveloping the manubrium mallei. The point of maximum elongation is located between the umbilicus and the annulus fibrocartilagineus, along the axis of the manubrium mallei. In this case, the motion of the umbilicus is approximately 7.5 times weaker than that of the point of maximum elongation. (auth)

9505 (ORNL-tr—4099) **Compilation of detailed accident prevention regulations of the employers' liability insurance associations: noise.** Dec 1974. Translated by R.G. Mansfield from the German. 5p. Dep. NTIS $3.50.

Regulation applicable to industries wherever they employ insured persons who are subject to the effect of noise are presented. Noise in the sense of this accident prevention regulation is sound (din) which can damage the hearing or result in special accident risks. The appraisal level in the sense of this accident prevention regulation characterizes the action of a noise on the hearing. It is the level of noise which is constant for the duration of an 8-hr work shift or, in the case of a level which varies with time, the level which is equated with the latter. It is expressed in dB(A). Noise areas in the sense of this accident prevention regulation are areas in which noise occurs by which an appraisal level of 90 dB(A) is reached or exceeded. (auth)

9506 Further studies on the nature of fluid compartmentalization in chick calvaria. Neuman, W.F.; Bareham, B.J. (Univ. of Rochester, NY). *Calcif. Tissue Res.;* **17**: 249-255(1975).

Labeled mannitol and polyethylene glycol (mol. wt. 4000), PEG, were used as space markers to estimate the fluid compartmentalization of calvaria taken from 3-5-day-old chicks. The mannitol results indicated that about 80 percent of the water in these bones is extracellular. Only a small fraction of this extracellular space was available to the diffusion of polyethylene glycol. Adsorption studies in vitro and prior incubation of the tissues with hydrolytic enzymes indicated that the phenomenon of exclusion of PEG was primarily physical in nature. The polyethylene polymer is excluded from the water of hydration of the mineral phase. Apparently much of the extracellular water (two-thirds) of bone is in the form of crystal hydration. (auth)

9507 (LF-tr—100) **Experimental investigation on the problem of sleep disturbances caused by sonic boom.** Jansen, G.; Griefahn, B. May 1975. Translation of ISL—21/74. 28p. Dep. NTIS $4.00.

In two series of tests, lasting 19 and 53 nights (test period: about 10:30 p.m. until 3:00 a.m.), the change in the electroencephalogram and the peripheral blood circulation caused by sonic booms during natural night sleep was tested (by using two test persons at a time). After the normal course of sleep was recorded for three nights, 2-4 sonic booms were alternately applied in the following 11-30 nights. Afterwards undisturbed sleep behavior was graphed for 5-10 nights. In the main series of experiments, four nights were added in which the subjects were subjected to 8-16 booms. This experimental series was ended after 6 further nights free of noise. Results are reported. (auth)

TRACER TECHNIQUES

9508 Improved technique for measuring assimilation efficiency by the ^{51}Cr—^{14}C twin tracer method. Wightman, J.A. (Oxford Univ.). *Oecologia (Berlin);* **19**: No. 4, 273-284(1975).

A technique to measure assimilation efficiency was tested using third instar larvae of a Kenyan cetoniid, Pachnoda ephippiata (Gerst.) (Coleoptera, Scarabaeidae), fed on an artificial food medium labelled with ^{14}C-glucose and $^{51}CrCl_3$. The activity of both tracers in food and faeces was estimated from simultaneous counts of the β emissions recorded by a liquid scintillation spectrometer. The scintillant solution, toluene—Triton X-100—PPO, extracted virtually all of the labelled tracers from 0.2 g samples of the agar-cellulose-water food medium. The calculated assimilation efficiency values for glucose increased from 50.2 percent to 78.6 percent over the 6 days following exposure to the labelled food. 90.8 percent of the total ^{51}Cr recovered was egested during these 6 days, 76.8 percent during the first 3. An ecologically more meaningful estimate of assimilation efficiency was calculated by integrating the ^{14}C and ^{51}Cr counts over the 15 days that faeces were collected. The applications of this approach to measuring assimilation efficiency are wide. They include the possibility of measuring how much excreta are produced from a given amount of Ingesta and of determining the role of gut-microorganisms in the assimilation of their host's food. (JWP)

9509 New isotope methods for estimating milk intake and yield. Holleman, D.F.; White, R.G.; Luick, J.R. (Inst. of Arctic Biology, Fairbanks, AK). *J. Dairy Sci.;* **58**: No. 12, 1814-1821(Dec 1975).

Two isotope tracer methods, based on the transfer of isotopic tracer via milk from a female to offspring, were developed for estimating milk intake of nursing offspring. One method depended upon the transfer of tritiated water from female to offspring in milk and simultaneous determination of water turnover of the offspring by deuterium oxide. The second method was based on the transfer of radiocesium from female to offspring in milk and required the use of whole body counting techniques for evaluating the radiocesium body burden of the offspring. Experiments evaluating the two methods were with hand-reared Holstein calves given fixed milk intake. The methods gave valid estimates of milk intake; estimates were within +- 2.5 percent of the actual intakes. The application and limitations of these methods for estimating milk intake and yield of other species are discussed. (auth)

AGRICULTURE AND FOOD TECHNOLOGY

9510 (CONF-760106—1) **Commercialization of raft oyster culture in Puerto Rico.** Watters, K.W. (Puerto Rico Nuclear Center, Mayaguez). 1975. 9p. Dep. NTIS $4.50.

From National fish culture workshop; Springfield, Missouri, United States of America "USA" (13 Jan 1976).

The Oyster Culture Project of the Puerto Rico Nuclear Center has been investigating the feasibility of raft-culturing the local mangrove oyster (Crassostrea rhizophorae) for the past two years. Attempts to start culture efforts on a commercial scale are described. (CH)

9511 Diazinon and carbaryl: effects on the vegetation of a soybean ecosystem. Draggan, S. (Rutgers—the State Univ., New Brunswick, NJ). *Bull., N. J. Acad. Sci.;* **20**: No. 1, 1-4(1975).

Two non-persistent insecticides, diazinon and carbaryl, were selected to assess their effect upon the vegetation component of a simplified agroecosystem located on the Piedmont Plateau of New Jersey. Vegetational analysis to determine the effect of the insecticide on the biomass of six species, including a miscellaneous grouping of small cover species, revealed the stimulation of three species (Raphanus raphanistrum, Agropyron repens, and Ambrosia artemisiifolia) and the inhibition of Convolvulus sepium. Vegetational differences between the insecticide treatments are attributed to diazinon's modifying effect of competition to the stimulated species. The changes attributed to diazinon treatment are viewed as neither beneficial or detrimental to the simplified ecosystem, but must be viewed as having potential to alter community structure, food web relationships, and mineral cycling within the experimental area. (auth)

TRACER TECHNIQUES

9512 (STI/DOC—10/170) **Root activity patterns of some tree crops. Technical reports series No. 170. Results of a five-year coordinated research program of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture.** Nethsinghe, D.A.; Broeshart, H. (International Atomic Energy Agency, Vienna (Austria)). 1975. 152p. IAEA $9.00.

Using a ^{32}P solution soil injection technique, seasonal root activity was studied. In most of the crops, root activity was highest near the soil surface, within the top 20 cm. The exceptions were orange trees in Spain, in which root activity was highest at 30 cm depth, and the dry season root activity of coffee in Kenya which was highest at 45 to 75 cm depth. In general, banana, young orange trees in Spain, mature coffee and coconut trees showed highest lateral root activity within 30 to 100 cm distance from the trees. In young citrus trees in Taiwan, mature orange in Spain, mature cocoa and oil palm trees in Malaysia, lateral root activity was highest at 100 to 300 cm distance. In the Ivory Coast the lateral root activity of mature oil palms was independent of distance from

the tree within the 100 to 400 cm distance tested. In wet and warm seasons all crops showed more intense root activity than in dry and cold seasons. In dry weather, the differences between root activity near the soil surface and lower depths were less than in wet seasons. There were no marked seasonal variations in patterns of root activity. Experimental data indicate that patterns of root activity can vary with soil type, tree variety and age. These are some areas for future research. Fertilizer placement experiments using ^{32}P labeled fertilizers on coconut, citrus, cocoa and coffee trees showed that application within the zones of highest root activity resulted in highest utilization by both the treated tree and neighboring trees. (auth)

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

9513 (BM-RI—7907) **Fast pulse processing for gamma-ray spectroscopy.** Fasching, G.E.; Patton, G.H. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). 1974. 14p.

A pulse-counting system is described that improves the energy resolution of less-precise γ-radiation detectors [e.g., NaI(Tl)] by minimizing pulse-pile-up distortion. A pile-up detector selects either a fast or a slow processing channel, depending on whether more than one pulse is recorded during the resolving time of the system. This system has been used for determinations of S in a continuous flow of coal (cf. Stewart et al., Analyt. Abstr.; 27: 3315(1974)). (Anal. Abstr.)

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

9514 (COO—690-47) **Effect of radiation on proteins and radiation effects in biochemistry and organic chemistry. Final report, October 15, 1957—October 14, 1974.** Tolbert, B.M. (Colorado Univ., Boulder (USA)). 1974. Contract E(11-1)-690. 126p. Dep. NTIS $5.50.

A summary is made of a fifteen year study of chemical effects of radiation of amino acids and proteins. Included is a list of publications: 54 papers, reports and abstracts, and 10 M.S. and Ph.D theses. The report concludes with details of the final two studies done under this contract. These are, first, a study of post-irradiation effects of various gases on gamma irradiated lysozyme. This study showed that H_2S, O_2, NO, and N_2O treatment changed the amount of aggregation products, and also that a certain amount of the irradiated lysozyme was subject to main chain cleavage. The second was a study of proteins in rabbit eye lens cataracts induced by x-irradiation or a high galactose diet. The cataract proteins were more soluble in water than normal proteins, and were present in lower amounts in the eye lens. (auth)

9515 **Radiation chemical studies of the sensitizer diamide.** Whillans, D.W.; Neta, P. (Mount Vernon Hospital, Northwood, Eng.). *Radiat. Res.*; **64**: No. 3, 416-430(Dec 1975).

A detailed study of the radiation chemistry of the radiosensitizer Diamide (diazenedicarboxylic acid bis-dimethylamide) using ^{60}Co irradiation, pulse radiolysis, pulse conductivity, and ESR techniques is presented. (SFL)

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

9516 (TID—26975, pp vp, Paper 2) **Radiation studies: radiation mechanisms in mammalian systems.** Laughlin, J.S.; Zeitz, L.; Djordjevic, B. 1975.

In Biological effects of radiation and related biochemical and physical studies, November 1, 1974—September 30, 1975.

Progress is reported on studies related to the effectiveness of fast neutrons for radiotherapy of solid tumors. Results are reported from studies on the survival of cultured mammalian cells (W 138, HeLa, and mouse melanoma cells) irradiated under oxic and anoxic conditions with or without BUdR treatment. The results are compared with the effects of x or γ irradiation. (CH)

9517 **RBE as a function of neutron energy. I. Experimental observations.** Hall, E.J.; Novak, J.K.; Kellerer, A.M.; Rossi, H.H.; Marino, S.; Goodman, L.J. (Columbia Univ., New York). Contract AT(11-1)-3243. *Radiat. Res.*; **64**: No. 2, 245-255(Nov 1975).

The survival of Chinese hamster cells in culture was used as a test system to determine the RBE of neutrons over a wide energy range. The Radiological Research Accelerator Facility (RARAF) at Brookhaven National Laboratory was used for experiments involving nine neutron energies between 110 keV and 15 MeV; for all but the lowest energy the beams were essentially monoenergetic. Additional experiments were performed with high energy cyclotron-produced neutrons at the Naval Research Laboratory, Washington, D. C., and at the Texas A and M Variable Energy Cyclotron (TAMVEC). In both cases broad neutron energy spectra were involved. In each experiment, survival curves were obtained for one neutron energy and compared with 250 kVp x rays, using cells from the same suspension and common controls. In this way a detailed study was made of the relation between RBE and neutron absorbed dose for each neutron energy. At any given cell survival level, RBE varies with neutron energy. Neutrons at 350 keV are biologically the most effective, the RBE falling off for both higher and lower neutron energies. (auth)

9518 **Effect of extreme hypoxia on the repair of DNA single-strand breaks in mammalian cells.** Koch, C.J.; Painter, R.B. (Univ. of California, San Francisco). *Radiat. Res.*; **64**: No. 2, 256-269(Nov 1975).

About 20 percent of the single-strand breaks produced by x rays in V79 Chinese hamster cells under extremely hypoxic conditions remain unrepaired after 1 hr at 37°C. The corresponding figure is only 10 percent for cells irradiated under moderately hypoxic (0.2 μM) or aerobic conditions (200 μM). The initial number of breaks produced per unit dose is identical for extremely hypoxic and moderately hypoxic cells and is about four times greater for aerobic cells. Because split-dose recovery proceeds under aerobic and moderately hypoxic conditions and is inhibited only under extremely hypoxic conditions, the split-dose recovery phenomenon may be related to the unrepaired component of single-strand breaks. (auth)

9519 **Radiosensitization of hypoxic mammalian cells by diamide. I. Effects of experimental conditions on survival.** Harris, J.W.; Power, J.A.; Koch, C.J. (Univ. of California, San Francisco). *Radiat. Res.*; **64**: No. 2, 270-280(Nov 1975).

Diamide sensitizes hypoxic mammalian cells to x radiation in a complex manner. It sensitizes CHO cells more effectively than V79-S171 cells and is far more efficient at 0°C than at 18°C in the presence of glucose. In the cold, diamide is more efficient than either nifuroxime or metronidazole (Flagyl), but this advantage is lost at 18°C. Low concentrations of diamide (40 to 100 μM, depending on cell line) decrease the extrapolation number to or close to 1 while affecting the D_0 only slightly, but higher concentrations decrease the D_0 to the euoxic level. The single-dose survival of V79 cells irradiated in the presence of increasing diamide concentrations follows a biphasic curve, with a break in the region of 200 to 300 μM. Since diamide is not inactivated by x radiation and since there is no evidence of differential sensitization of cells in M, G_1, late S, or plateau-phase G_1/G_0, we interpret these data to mean that diamide acts by at least two mechanisms, one operating mainly at low concentrations to reduce the shoulder and the other predominating at high concentrations to decrease the D_0. (auth)

9520 **Estimation of life times and diffusion distances of radicals involved in x-ray-induced DNA strand breaks of killing of mammalian cells.** Roots, R.; Okada, S. (Univ. of Rochester, NY). *Radiat. Res.*; **64**: No. 2, 306-320(Nov 1975).

We have used a mammalian tissue culture system to calculate the life times and diffusion distances in DNA scissions as well as cell killing for the three main products of water radiolysis: OH, H, and e^-/sub aq/. Using various alcohols as radical scavengers, the average life time for OH in DNA single-strand breaks was calculated to be about 4×10^{-9} sec. Using the same data and published rate constants, the apparent life time of H atoms was calculated to vary from about 2×10^{-7} to 4×10^{-6} sec and, similarly, the calculated life time of the hydrated electron was found to vary more than was the case for OH. From these life times, the radical diffusion distances were estimated to be approximately 60 A for OH, which is reasonable, but the values for both H and e^-/sub aq/ were unrealistically large, i.e., 880 to 4040 A for H and 9590 to 19,810 A for e^-/sub aq/. In cell killing, the OH radical life time was estimated to be about 8.7×10^{-9} sec which gives an average diffusion distance for this radical of about 93 A. Our data support the idea that OH is the radical species primarily responsible for the indirect effect in radiation injury measured as DNA single-strand breaks or cell killing, and that H and e^-/sub aq/ are not significantly involved. (auth)

9521 Intracellular cyclic AMP levels and radiosensitivity in synchronized Vc79 cells. Lehnert, S. (Columbia Coll. of Physicians and Surgeons, NY). *Radiat. Res.*; **64**: No. 2, 394-398(Nov 1975).

Cyclic AMP was assayed in V-79 Chinese hamster lung cells at various times after synchronization by shake-off of mitotic cells. Highest concentrations were found 2 to 6 hr after synchronization (S phase), while lowest concentrations were in mitotic cells. x-ray survival curves were prepared at various times during the division cycle, and extrapolation number was found to be highest during the period when intracellular cyclic AMP level was at a maximum. Conversely, in mitotic cells where cyclic AMP concentration is at a minimum extrapolation number was 1. Survival curves prepared using cells in which intracellular cyclic AMP level was elevated by drugs are characterized by higher extrapolation number and lower D_0 than controls. It is postulated that changes in cyclic AMP during the division cycle may be one of the factors which produce the characteristic changes in radiation response observed as the cell traverses the cycle. (auth)

9522 X-ray-induced inhibition of DNA synthesis in Chinese hamster ovary, human HeLa and mouse L cells. Painter, R.B.; Young, B.R. (Univ. of California, San Francisco). *Radiat. Res.*; **64**: No. 3, 648-656(Dec 1975).

An X-ray dose of 500 rad inhibits DNA synthesis in Chinese hamster ovary (CHO) cells, in HeLa S3 cells, and in mouse L cells. In no case can the inhibition we observed be explained on the basis of a pool effect or any other process that causes deficient use of exogenously supplied DNA precursors. In all cases the inhibition is mediated by a decrease in replicon initiation processes. Since this inhibition is observed at doses too low to affect individual replicons, we hypothesize that a single hit within a cluster of replicons in some manner blocks the initiation of all replicons within the cluster. (auth)

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

9523 (SAND—75-0611) **Beneficial Uses Program. Progress report, period ending September 30, 1975.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 45p. Dep. NTIS $5.00.

Progress is reported on a program that involves a number of activities at Sandia Laboratories to develop the necessary technology for cost-beneficial use of a maximum amount of radioactive waste. Major activity is currently concentrated in the Waste Resources Utilization Program which has as its objective the use of cesium-134/137 as a gamma radiation source, coupled with modest heating, to treat sewage sludge to rid it of pathogenic organisms so that it may be safely used as a fertilizer or a feed supplement for ruminant animals. Other activities included in the Beneficial Uses Program are efforts to: (1) develop a cost-effective radioisotope separation technology based on column separation techniques associated with the Sandia Solidification Process and (2) develop a broader technology for beneficial applications of the separated isotopes. (auth)

9524 Induction of λ-prophage by ionizing radiation. Lydersen, B.K.; Pollard, E.C. (Pennsylvania State Univ., University Park). *Radiat. Res.*; **64**: No. 2, 237-244(Nov 1975).

The dose-response relationship for the induction of lambda-prophage is a composite of the induction process and the capacity for phage development. Consequently, the character of the relation is hard to establish. Induction of lambda can be separated from capacity by studying the loss of immunity consequent on the derepression caused by ionizing radiation. The loss of immunity proves to be insensitive with a D_{37} of 100 krad and shows an oxygen enhancement ratio of two or greater. The capacity for prophage development has a 37 percent survival dose of 45 krad and exhibits an oxygen enhancement ratio of greater than 2. These findings suggest that there is a low yield of induction by ionizing radiation because the sensitivity of the capacity is greater than the probability of induction. (auth)

RADIOSTERILIZATION OF MEDICAL SUPPLIES

9525 (AEC-tr—7315, pp 34-37) **Evaluation of the heterogeneity of the absorbed dose in blood sampling and transfusion systems during their sterilisation with accelerated electrons.** Vanyushkin, B.M.; Kon'kov, N.G.; Krylov, S.Yu.; Rumyantsev, S.A.; Tetekin, Yu.S. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

It is always required, in the irradiation of different products by accelerated electrons, that the distribution of the absorbed dose over the volume is within the specified limit. In the irradiation of block product, a way is chosen so that the input and output doses are almost equal. The situation becomes complicated when it is required to irradiate a highly heterogeneous product with electrons of an energy which does not exceed a certain value. Such products include all the possible medical articles, e.g., systems for sampling and transfusion of blood, ampoules, and injector tubings. These are widely sterilized by the radiation method. Regardless of the small average density, all these articles have thicknesses which are localized in separate directions, and which frequently exceed the value of the range of electrons. Methods are suggested for evaluation of the volume homogeneity of irradiation for blood sampling and transfusion systems. (auth)

VACCINE PREPARATION AND OTHER APPLICATIONS

REFER ALSO TO CITATION(S) 8349

RADIATION EFFECTS ON PLANTS

BASIC STUDIES

9526 (ERDA-tr—51, pp 168-171) **Study of the effectiveness of gamma irradiation of the saffron.** Akhund-Zade, I.M.; Muzaferova, R.Sh. (Academy of Sciences Azerbaidzhan SSSR, Baku). 1975. Translated from Radiobiologiya; 15: No. 2, 319-322(1975).

In Radiobiology.

9527 Dose rate, mitotic cycle duration, and sensitivity of cell transitions from G1 yields S and G2 yields M to protracted gamma radiation in root meristems. Evans, L.S.; Hof, J.V. (Brookhaven National Lab., Upton, NY). *Radiat. Res.*; **64**: No. 2, 331-343(Nov 1975).

Experiments were designed to determine the relative radiosensitivity of the cell transition points of G1 yields S and G2 yields M in root meristems of several plant species. Label and mitotic indices and microspectrophotometry were used to measure the proportions of cells in each mitotic cycle stage in root meristems after protracted gamma radiation. The criterion of radiosensitivity was the dose rate needed to produce a tissue with less than 1 percent cells in S and none in M after 3 days of continuous exposure. The results show that DNA is the primary radiation target in proliferative root meristems and that the cycle duration stipulates the time interval of vulnerability. In each species, nonrandom reproducible cell proportions were established with 2C:4C:8C amounts of nuclear DNA after 3 days of exposure. Roots of Helianthus annuus, Crepis capillaris, and Tradescantia clone 02 had 80 percent cells with a 2C amount of DNA and 20 percent had a 4C amount of DNA. In these species the transition point of G1 yields S was more radiosensitive than G2 yields M. Roots of Pisum sativum and Triticum aestivum had cell proportions at 2C:4C:8C amounts of DNA in frequencies of 0.10 to 0.20:0.40 to 0.60:0.30 to 0.40. In these two species 0.30 to 0.40 cells underwent radiation-induced endoreduplication that resulted from a rapid inhibition of cell transit from G2 yields M and a slower impairment of G1 yields S. Cells increased from 2C to 4C and from 4C to 8C amounts of DNA during irradiation. The proportions of nuclei with 2C:4C:8C amounts of DNA were dependent in part upon the relative radiosensitivity of the G1 yields S and G2 yields M control points. The data show the relative radiosensitivity of the transition points from G1 yields S and from G2 yields M was species specific and unrelated to the cycle duration and mean nuclear DNA content of the plant species. (auth)

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 8324, 9172, 9552

9528 (ORNL/TM—5337) **Radiation insult to the active bone marrow as predicted by a method of CHORDS.** Jones, T.D. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 29p. Dep. NTIS $4.00.

Critical Human Organ Radiation Dosimetry (CHORD) probability density functions for A-P, P-A, bilateral, rotational, and isotropic incidence, plus simple depth-dose data, permit the rapid estimation of the radiation insult to the active red bone marrow system of the ICRP Reference Man. The CHORD concept follows

the variations in the microscopic processes of absorption, attenuation, and scattering on a macroscopic level so that it is not necessary to attempt detailed calculations for each and every case of interest. Similar techniques have been applied to reactor criticality calculations and the general logic of the CHORD process can be applied to any cause-response type situation which can be described in terms of variation with distance in the medium of interest. Doses to active bone marrow from exposures to photons and neutrons are presented and excellent agreement was found with the few available experimental results.

VERTEBRATES

9529 Modification of radiation lethality by previous treatment with butylated hydroxytoluene. Clapp, N.K.; Satterfield, L.C. (Oak Ridge National Lab., TN). *Radiat. Res.*; **64**: No. 2, 388-392(Nov 1975).

Young adult BALB/c mice of both sexes were irradiated with 525 to 750 R of x rays with and without a prefeeding of 0.75 percent butylated hydroxytoluene (BHT) in the feed. In contrast to a previous observation in $C31F_1$ mice, no potentiation of radiation lethality was observed with BHT treatment in either sex. Instead, a suggestion of radiation protection was observed at all doses below that which produced 100 percent lethality. $LD_{50}/_{30}$ values in females were 628 R for radiation alone and 643 R for BHT plus radiation; LD_{50}'s for males were 581 R for radiation and 622 R for BHT plus radiation. These differences were significant at P less than 0.05 and P less than 0.01, respectively. The difference in effect may be related to the genetic differences between the inbred BALB/c mice and the hybrid $C31F_1$. (auth)

9530 Design of an experiment to study leukemogenesis in mice irradiated by energetic heavy ions. Patrick, J.W.; Stephens, L.D.; Thomas, R.H.; Kelly, L.S. (Univ. of California, Berkeley). *Radiat. Res.*; **64**: No. 3, 492-508(Dec 1975).

The design of an experiment to study the incidence of cancer and hematological effects in mice irradiated by heavy ions is described. A beam of fully stripped C^{6+} ions of energy 250 MeV/amu was produced by the Bevatron. Mice were irradiated in groups of 12 by rotating them in a wide beam (11.4 cm FWHM) once per minute. At a beam intensity of 10^8 ions per pulse irradiations of 250 animals to absorbed doses of 200 rad were completed in a few hours, an efficient use of accelerator beam time. The average LET of the radiation was 16.6 keV/μm with a spread in the animal of +-2 keV/μm. Radial and longitudinal variations in absorbed dose were less than 30 percent and 15 percent, respectively. Estimates of tissue-entrance absorbed doses with an ionization chamber and with thermoluminescent dosimeters differed by less than 3 percent. (auth)

9531 Biochemical effects of x-radiation on the retina of the albino rabbit. Newton, J.C.; Barsa-Newton, M.C.; Jacobson, J.H.; Krohn, D.L. (New York Eye and Ear Infirmary, NY). *Radiat. Res.*; **64**: No. 3, 518-523(Dec 1975).

The effects of x radiation on the oxygen consumption, anaerobic glycolysis, cytochrome oxidase, succinic, lactic, and malic dehydrogenase activities of the rabbit retina were investigated. These activities were inhibited by over 50 percent when 7000 rad were administered. The only exception was anaerobic glycolysis, which was only inhibited by 13 percent. With higher doses of x radiation, the toxic effects rose proportionately with the dose. (auth)

INVERTEBRATES

9532 (COO—2001-12) **Genetic effects of low x-ray doses. Progress report, September 16, 1974—September 30, 1975.** Abrahamson, S.; Meyer, H.U. (Wisconsin Univ., Madison (USA)). Sep 1975. Contract E(11-1)-2001. 24p. Dep. NTIS $3.50.

Results are reported from large-scale experiments on the dose-kinetics of x-ray induced sex-linked lethal mutations in treated oogonia of Drosophila. (auth)

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

9533 (ORNL—5046, pp 219-220) **Practical consideration for computing the dose to the bladder.** Smith, E.M.; Warner, G.G. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

The various factors that will affect the radiation dose to the wall of the bladder of patients following the administration of radiopharmaceuticals labeled with ^{197}Hg or ^{203}Hg were evaluated. The factors studied included: total daily urine output; voiding schedule, volume of urine in the bladder at the time the radioactivity was administered, and stimulation of urine production. (CH)

MAN

REFER ALSO TO CITATION(S) 9552

9534 (ORNL—5046, pp 197-204) **Metabolic models for estimation of internal radiation exposure received by human subjects from the inhalation of noble gases.** Bernard, S.R.; Snyder, W.S. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Metabolic models needed for the estimation of radiation dose equivalents from exposure of human populations to atmospheric noble gases (^{133}Xe, ^{85}Kr, and ^{41}Ar) were developed. (CH)

9535 (ORNL—5046, pp 221) **Metabolic model for whole-body and gastrointestinal-tract retention of ^{141}Ce in a human infant.** Bernard, S.R. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

A metabolic model for whole-body and gastrointestinal tract retention of ^{141}Ce in infant rats and dogs was extrapolated to a human infant. The radiation dose following a single intake of 1 μCi of ^{141}Ce nitrate was estimated. (CH)

9536 (ORNL—5046, pp 222-224) **Dosimetry of ^{241}Pu reconsidered.** Poston, J.W.; Snyder, W.S.; Owen, L.W. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Plutonium-241 is a pure beta emitter having a radioactive half-life of 13.2 years, a maximum energy of 20.8 keV, and an average energy of 5.2 keV[3]. Its range in tissue is about 8.2 μm, which is far shorter than the range of most alpha particles. This has prompted us to consider carefully whether the dosimetry generally used for the alpha particles from ^{239}Pu or ^{239}Pu is appropriate for this beta emitter. The retention model used for alpha-emitting radionuclides of Pu, the standard ICRP lung model, and a particle size of 1 μm average median aerodynamic diameter (AMAD) were used. An inhalation exposure of personnel to a class Y aerosol of pure ^{241}Pu and the dose over 50 years post-exposure for a single intake of this radionuclide were calculated. (CH)

9537 (ORNL—5046, pp 225-229) **Computer program for estimating microcuire-days of a radionuclide in the organs of the human body.** Snyder, W.S.; Ford, M.R.; Watson, S.B. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

A computer code was developed that embodies a system of differential equations to represent the transfer of activity in the body following radionuclide intake that assumes that retention can be adequately represented by a system of compartments with constant rates of transfer to other organs or out of the body. The ^{226}Ra chain was used as the test case. Integration of the equations for the chain of eight radionuclides for the time period of 50 years following intake or computer required execution time of only 9 sec. (CH)

9538 (SRL—76003) **Safety analysis of singly encapsulated ^{252}Cf medical sources, model ALC-PXC.** Permar, P.H. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Feb 1976. 20p. Dep. NTIS $3.50.

The document describes the singly encapsulated ^{252}Cf neutron sources used in cancer therapy. These sources are fabricated by the Savannah River Laboratory and are loaned by the U. S. Energy Research and Development Administration under contract agreement to medical organizations for evaluation of ^{252}Cf in the treatment of cancer. These neutron sources are classed as special form radioactive materials and as such must meet certain Regulations prescribed by the U. S. Department of Transportation. The document describes the tests that have been performed and shows that these medical sources do meet the applicable DOT Regulations. The document is written to demonstrate compliance with appropriate paragraphs in Sections VII, VIII of "Regulations for Safe Transport of Radioactive Materials, IAEA Safety Standards, Safety Series No. 6—1973 Revised Edition."

9539 (LF-tr—103) **Collagen biosynthesis in the lungs of rats with radiation injury.** Tseveleva, I.A. Translated from *Vopr. Med. Khim.*; **20**: 640-643(1974). 8p. Dep. NTIS $3.50.

Biosynthesis of collagen proteins in the sclerosis process in the lungs during injury by plutonium is being studied. It is shown that an accumulation of collagen in lung fiber is the result of increasing biosynthesis of the given protein. The increase in content of soluble fractions of collagen of the lungs and more intense inclusion of H^3-proline [2-pyrrolidinecarboxylic acid] in the collagen are evidence of this. (auth)

ANIMALS

9540 (UCD—472-122, pp 82-89) **Retention and distribution of radium and radon during and after fractional administration.** Parks, N.J.; Abrahams, C.D.; Tsuboi, K.K. Jun 1975.

In Annual report, fiscal year 1975.

Direct measurement of Ra and Rn metabolism during the administration of eight semi-monthly injections has been made with beagles exposed to a total of similarly ordered 4.3 μCi/kg. No variation of radium retention function with succeeding injections was found. The early distribution of activity is similarly ordered 98.5% skeletal, 1.0 +- 0.5% in the eyes, and the remaining similarly ordered 0.5% equitably distributed in soft tissue and plasma. Intraskeletal specific activity measurements of animals 0.6 and 7 years post-exposure are temporally and spatially compatible to human data for average post-exposure time of 15 years. Radon content of Beagles fractionally exposed to radium has been determined by gamma-spectroscopy and direct assay from initial exposure to 10 years. Physiologically damaging levels of radium exposure influence radon retention. (auth)

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 9172, 9535

9541 (HASL—299) **General population exposure of stable lead and ^{210}Pb to residents of New York City.** Bogen, D.C.; Welford, G.A.; Morse, R. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). Dec 1975. 19p. Dep. NTIS $3.50.

Stable lead and ^{210}Pb intake, ingestion, and inhalation by residents of New York City were determined. Measurement of excreta samples provided data to establish a mass balance of stable lead and ^{210}Pb. These results indicate that no more than 5 μg of stable lead and 0.1 pCi of ^{210}Pb are retained daily by residents of New York City. Analyses of bone samples have provided estimates of the skeletal burden of stable lead and ^{210}Pb. Using the ICRP model, intake data, and assuming 100 percent skeletal deposition, the calculated stable lead and ^{210}Pb values are in good agreement with the experimental results. The data indicate that inhalation is the principle source of stable lead to residents in New York City. (auth)

9542 (ORNL—5046, pp 230-232) **Semitheoretical approach to excretion and retention of various ions.** Henley, L.C. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Methods for the prediction of the urinary excretion rates of Pu and Am in man are described that are based on measured excretion rate of ^{90}Sr and ^{147}Pm. The influence of the properties of ions to form complexes is considered. It was assumed that the dielectric constant of the extracellular fluid in man and the absorption properties of his cellular tissue are constant and that Pu in man exists in only the tetrapositive state. (CH)

ANIMALS

REFER ALSO TO CITATION(S) 9540

9543 **Increased ^{144}Ce uptake in fetal rats after the addition of carrier.** Mraz, F.R.; Eisele, G.R. (Comparative Animal Research Lab., Oak Ridge, TN). *Radiat. Res.*; **64**: No. 2, 399-400(Nov 1975).

Rats on their 17th day of gestation were given ^{144}Ce intravenously, either carrier-free or with 143 μg Ce. They were sacrificed 48 hr later, and the ^{144}Ce contents of their fetuses were determined. The fetuses from the dams that received cerium carrier contained 50 percent more ^{144}Ce than did those from dams that received no carrier. (auth)

PLANTS

9544 **Cobalt accumulation and circulation by blackgum trees.** Thomas, W.A. (Oak Ridge National Lab., TN). *For. Sci.*; **21**: No. 3, 222-226(Sep 1975).

Blackgum (Nyssa sylvatica Marsh.) trees accumulate far greater concentrations of cobalt in mature foliage than do other species on the same site (363 ppM in ash of blackgum, compared with about 3 ppM by mockernut hickory and about 1 ppM by red maple, tulip tree, and white oak). Cobalt concentrations in dormant woody tissues of blackgum also significantly exceed those in the other four species. Inoculation of six blackgums with ^{60}Co revealed that cobalt remains mobile in the trees for at least 3 years. Foliar concentrations of stable cobalt increase uniformly until senescence. In late August, foliage accounts for only 9 percent of total tree weight but 57 percent of total tree cobalt. Losses of cobalt from trees occur almost entirely by leaf abscission, and the loss rates of weight and cobalt from decomposing litter are similar. Retention of cobalt in the biologically active soil layers perpetuates zones of cobalt concentration created by this species in woodlands. (auth)

THERMAL EFFECTS

REFER ALSO TO CITATION(S) 8894

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 8116, 8226, 8282

9545 (NTIS/PS—75/210) **Biological effects of mercury pollution. A bibliography with abstracts. Search period covered: 1964—October 1974.** Werner, K.G. (National Technical Information Service, Springfield, Va. (USA)). Feb 1975. 166p. NTIS $25.00.

The effects of mercury in the environment are surveyed in this bibliography of 112 abstracts. Mercury toxicity, poisoning, absorption, excretion, bioaccumulation, and concentration levels in various plants, animals, and humans are covered. See also Published Search, NTIS/PS-75/209, Mercury Pollution. (NTIS)

9546 (NTIS/PS—75/268) **Biological effects of lead pollution. A bibliography with abstracts. Search period covered: 1964—October 1974.** Werner, K.G. (National Technical Information Service, Springfield, Va. (USA)). Feb 1975. 163p. NTIS $25.00.

The effects of environmental lead contamination on plants, animals, and humans are covered by the 109 selected abstracts of this bibliography. Included are references which concern the distribution and quantities of lead found in various plants and animals. See also NTIS/PS-75/267, Lead Pollution. (NTIS)

MICROORGANISMS

9547 (SGAE—2456) **Investigations on the uptake of mercury ions by Chlorella fusca and Chlamydomonas reinhardi.** Eisenreich, W.; Wihlidal, H.; Stehlik, G.; Biebl, R. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Jun 1975. 23p. (In German). (BL—139/75). Dep. NTIS (US Sales Only) $3.50.

The uptake of labeled mercury ions (taken as ^{203}Hg-acetate) was investigated on two different unicellular algae, Chlorella fusca and Chlamydomonas reinhardi. During the first hours of the experiments both organisms, cultivated asynchronously, showed comparatively quick and strong uptakes of mercury ions, being independent of any supply of energy (light, heat). Uptake-tests applied to synchronous algae cell cultures further demonstrated independence of the cells' physiological condition. The results suggest a passive transport of mercury ions at Chlorella fusca and Chlamydomonas reinhardi or a strong binding to the cell wall. (auth)

PLANTS

REFER ALSO TO CITATION(S) 9389

VERTEBRATES

REFER ALSO TO CITATION(S) 8295

9548 **Identification of phthalic acid esters in the tissues of cyprinodont fish and their activity as heartrate depressors.** Pfuderer, P.; Janzen, S.; Rainey, W.T. Jr. (Oak Ridge National Lab., TN). *Environ. Res.*; **9**: No. 3, 215-223(Jun 1975).

Two substances isolated from carp liver have been identified as dioctyl phthalate and butylbenzyl phthalate. When partially purified from fish liver by two-step column chromatography, these esters exhibited heartrate depressor activity. A pure sample of dioctyl phthalate was not active in the assay, however, while a sample of butylbenzyl phthalate containing 1.5% dibutyl phthalate was slightly active, probably due to the dibutyl phthalate it contained. A third phthalate ester, dibutyl phthalate, has also been found in carp liver, in lower concentrations than the other esters, and is a heartrate depressor. Pure samples of dibutyl phthalate

remained active at levels of 5 ppm and higher. We are forced to conclude either that traces of a compound which complexes or enhances the activity of dioctyl and butylbenzyl phthalate is responsible for their activity, or that traces of a more active compound are present with them. Dioctyl phthalate was also shown to form complexes in ethanol with fish lipids, presumably with fish di- and triglycerides. (auth)

9549 Ultrastructural changes in rat hepatocytes following acute methyl mercury intoxication. Desnoyers, P.A.; Chang, L.W. (Univ. of Wisconsin, Madison). *Environ. Res.*; **9**: No. 3, 224-239(Jun 1975).

Male rats were given daily subcutaneous injections of methylmercuric chloride (CH_3HgCl) at a dosage of 10 mg/kg body weight for 4 days. The earliest ultrastructural changes consisted of dilatation of the rough endoplasmic reticulum, wavy transformation of the mitochondrial membranes and occasional accumulation of liposomes. Focal areas of cytoplasmic degradation were observed 1 day after the initial administration of mercury. An increased number of lysosomes as well as swelling and floccular degeneration of the mitochondria were frequently observed at 2 days. Sequestration of cytoplasmic organelles within the hepatocytes, extrusion of degenerated hepatic organelles and cytoplasmic debris into the sinusoid could be observed 24 hours after the initial mercury administration and became a frequent finding after 4 days of intoxication. (auth)

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

9550 (ORNL-tr—4105) **Implementing regulations and illustrations, December 1974 for accident-prevention regulation: noise.** 1 Dec 1974. Translated by R.G. Mansfield from the German. 8p. Dep. NTIS $3.50.

The implementation of regulations of the German Federal Republic for protection of personnel of industrial plants against noise is discussed. (CH)

9551 Biochemical and neuroendocrine aspects of exposure to microwaves. Michaelson, S.M.; Houk, W.M.; Lebda, N.J.A.; Lu, S.T.; Magin, R.L. (Univ. of Rochester, NY). *Ann. N.Y. Acad. Sci.*; **247**: 21-45(28 Feb 1975).

Functional alterations in the neuroendocrine system of both animals and humans exposed to microwave or radiofrequency (mw/rf) energies have been reported by several investigators. The findings include changes in the secretions of the pituitary gland, adrenal cortex, thyroid gland, and the gonads. Certain investigators believe such changes result from stimulation of the hypothalamic-hypophysial system due to thermal interactions at the hypothalamic or immediately adjacent levels of organization, the hypophysis itself (pituitary), or the particular endocrine gland or end-organ under study. According to other researchers, the observed changes have been interpreted to be the result of direct microwave interactions with the central nervous system. Regardless of which mechanism is responsible for the observed responses, there is no question that this highly integrated, extremely labile system, which is intimately linked to the central nervous system, has a great potential for study. On this basis, it is reasonable to expect that alterations in the levels of the secretory products of these organs will occur in response to microwave exposure at some time/intensity relationship. (auth)

HEALTH AND SAFETY

9552 (BNL—20767) **Marshall Islands radiological followup.** Greenhouse, N.A.; McCraw, T.F. (Brookhaven National Lab., Upton, N.Y. (USA)). [nd]. 6p. (CONF-760202—24). Dep. NTIS $3.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

In August, 1968, President Johnson announced that the people of Bikini Atoll would be able to return to their homeland. Thereafter, similar approval was given for the return of the peoples of Enewetak. These two regions, which comprised the Pacific Nuclear Testing Areas from 1946 to 1958, will probably be repopulated by the original inhabitants and their families within the next year. As part of its continuing responsibility to insure the public health and safety in connection with the nuclear programs under its sponsorship, ERDA (formerly AEC) has contracted Brookhaven National Laboratory to establish radiological safety and environmental monitoring programs for the returning Bikini and Enewetak peoples. These programs are described in the following paper. They are designed to define the external radiation environment, assess radiation doses from internal emitters in the human food chain, make long range predictions of total doses and dose commitments to individuals and to each population group, and to suggest actions which will minimize doses via the more significant pathways. (auth)

9553 (ERDA—76-22) **Proposed ERDA pest control plans and practices for 1976.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Operational Safety). 1976. 232p. Dep. NTIS $7.60.

This report is a compilation of information on pesticides and uses planned at ERDA facilities during calendar year 1976, as compiled from pest control plans and practices prepared and submitted by ERDA contractor and field organizations. The ERDA Pest Control Program is designed to assure that pesticide operations and practices are conducted in a safe and environmentally acceptable manner. Toward this end, copies of this report are submitted for review to the Federal Working Group on Pest Management, Council on Environmental Quality. (auth)

9554 (NTIS/PS—75/286) **Hazardous materials transportation. A bibliography with abstracts. Period covered by report: 1964—December 1974.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Feb 1975. 177p. NTIS $25.00.

The transportation of explosives, rocket propellants, chemical warfare agents, industrial chemicals, liquified natural gas, chlorine, and other hazardous materials are covered in this bibliography which contains 126 abstracts. All means of transportation are described. Accidents, economics, and statistics are also included in these reports. Radioactive wastes are excluded. (auth)

9555 (UCRL—5007-75-1, pp 20-24) **Fire safety: HEPA-filter fire protection.** 15 Aug 1975.

In Hazards control progress report No. 50, January—June 1975.

HEPA-filter smoke plugging tests, construction of a large-scale fire test cell, and smoke chamber measurements of 23 materials performed in round robin tests for the American Society for Testing and Materials. (GHT)

9556 (ORNL-tr—4104) **Effects of a uniform magnetic field on blood.** Bellossi, A.; Bresson, Y.; de Certaines, J. Translated by M. Gerrard from *C. R. Soc. Biol.*; **165**: No. 6, 1503-1506(1971). 4p. Dep. NTIS $3.50.

After exposure of blood to a uniform magnetic field, modifications in leucocyte sedimentation following centrifugation and some hemolysis were noted. In order to try to determine the causative factors in detail, possible modifications of the pH and of the plasma surface tension, of the number of globules, and of the sedimentation rate of the blood resulting from the action of such fields were studied. The measurements were made on different blood samples, except that of the pH and the surface tension. No conclusions were reached. (CH)

PHYSICS RESEARCH

9557 (UCRL—51969) **Computerized data base of the fundamental constants of nature.** Henry, E.A.; Hampel, V.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Dec 1975. Contract W-7405-Eng-48. 18p. Dep. NTIS $4.00.

Fifty-seven fundamental constants of nature were computerized from the up-to-date evaluations of E. R. Cohen and B. N. Taylor. The constants are annotated with regard to symbol, value, uncertainty, and scaling factor. This computerization is part of the scientific data base project of the Information Research Group at Lawrence Livermore Laboratory. The MASTER CONTROL data base management system is used. The computerized fundamental constants can be requested from the ERDA Computer Program Exchange and Information Center of the Argonne National Laboratory or from the National Technical Information Service of the U. S. Department of Commerce. This is the first of a series of releases on preparation of computerized scientific and technological data banks. The next release is a data bank of conversion factors for different units of measurements. 3 figures.

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 9647

9558 Cosmic gamma-ray bursts. Strong, I.B. (Los Alamos Scientific Lab., NM). pp 47-58 of In Neutron stars, black holes, and binary x-ray sources. Gursky, H. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1975).

The recent discovery by the Vela satellite system of short, extremely intense, bursts of gamma rays originating outside the solar system, and the subsequent confirmation by a number of other independent observers, are described. The known properties of these so-called gamma-ray bursts are given together with outlines of some of the more promising explanations produced so far Essentially all these explanations invoke compact stellar objects—that is, dwarf stars, neutron stars or black holes. (auth)

STARS

REFER ALSO TO CITATION(S) 9558, 9946, 9948

9559 Stationary axisymmetric electromagnetic fields around a rotating black hole. Petterson, J.A. (Physics Department, Yale University, New Haven, Connecticut 06520). *Phys. Rev., D;* **12**: No. 8, 2218-2225(15 Oct 1975).

The form of stationary electromagnetic fields which are axisymmetric around a rotating black hole is derived, using Teukolsky's perturbation equation. The field of a circular equatorial charged current loop around the black hole is obtained, and it is shown that in a minimum-energy configuration the black hole and the current loop contain an equal but opposite net charge. The value of this equilibrium net charge is calculated. (AIP)

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 9729

9560 Solar wind electrons. Feldman, W.C.; Asbridge, J.R.; Bame, S.J.; Montgomery, M.D.; Gary, S.P. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *J. Geophys. Res.;* **80**: No. 31, 4181-4196(1 Nov 1975).

Average characteristics of solar wind electron velocity distributions as well as the range and nature of their variations are presented. The measured distributions are generally symmetric about the heat flux direction and are adequately parameterized by the superposition of a nearly bi-Maxwellian function which characterizes the low-energy electrons and a bi-Maxwellian function with characterizes a distinct, ubiquitous component of higher-energy electrons. An alternate self-consistent description of the higher-energy component is presented in terms of an unbound population of hot electrons with energy greater than some breakpoint energy of ≅60 V. The largest-scale parameter variations appear to come most often in association with high-speed streams. The salient electron parameter variations assoicated with these structures are presented and discussed. The mechanism by which interplanetary electrons conduct heat is convection of the hot component relative to the bulk speed. Arguments are presented which favor the local regulation of the solar wind heat flux at 1 AU. (AIP)

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 9716

9561 Numerical orbits near the triangular lunar libration points. Katz, J.I. (Univ. of California, Livermore). *Icarus;* **25**: 356-359(1975).

The behavior of a test particle placed at a triangular libration point of the Earth-Moon system is calculated using Newton's equations for the four-body problem, with arbitrarily chosen initial conditions. If the orbits of the massive bodies have their real eccentricities, then the test particle leaves the vicinity of the libration point in three years, much faster than if the orbits were circular. Very small particles are affected by solar radiation pressure, and may leave even faster. (auth)

AURORAL AND IONOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 9605

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 9983, 10014

9562 (ORNL—5046, pp 114-119) **Physics of liquids and surfaces.** Birkhoff, R.D.; Emerson, L.C.; Ashley, J.C.; MacRae, R.A.; Heller, J.M.; Painter, L.R. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics covered include: photon scattering from surfaces; collective electronic oscillations in liquids; thickness of contamination on the ORMAK liner; and electron energy losses in liquids. 8 figures. (GHT)

9563 (SAND—75-0331) **Analysis of targets with nonuniform composition as a function of depth: elastic and inelastic scattering.** Langley, R.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 33p. Dep. NTIS $4.00.

An analytical technique to reduce yield versus energy spectra to impurity concentration versus depth is described. It applies to both elastic and inelastic reactions and calculates the depth distribution profile directly from the observed data. It uses the experimental spectrum to be analyzed, stopping cross sections and reaction cross sections to obtain the desired depth scales and the depth dependence of the target composition. A computer code, NUCREA, has been developed to perform such analysis. A description of NUCREA, a user's guide, a complete listing and a typical output for the code are contained in the report. An example showing the analysis of experimental data is also presented.

9564 Deep craters produced by shock focusing in relativistic electron-beam diodes. Kelly, J.G.; Widner, M.M. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.;* **46**: No. 10, 4515-4518(Oct 1975).

Narrow craters have been produced in aluminum-rod targets mounted in the anode of the Nereus electron-beam accelerator (150 kV, 50 kA, 40 ns). These craters (~ 0.025 cm in diameter), which are characteristically deeper than their diameter and which extend into the electrode materials significantly beyond the classical range of the primary electrons in a relativistic electron-beam diode, were generated by a converging shock wave that melted and fractured the material in the region of shock focus. It is suggested that similar craters seen by other experimenters were also produced by the same mechanism. (auth)

9565 Solid state structure effects in fluorine x-ray spectra produced by heavy ion bombardment. Moore, C.F.; Matthews, D.L.; Wolter, H.H. (Texas Univ., Austin (USA). Dept. of Physics). *Phys. Lett., A;* **54**: No. 5, 407-408(6 Oct 1975).

Fluorine X-ray spectra produced by proton, alpha particle and oxygen ion bombardment of targets of LiF, NaF, CaF_2 have been measured. The Kα satellite yields of fluorine are different in each fluorine crystal due to the electronic structure of the compounds, however, the Kα hypersatellite yields are nearly identical. (NL)

9566 Alignment and orientation effects in beam-foil experiments. Band, Y.B. (James Franck Institute, University of Chicago, Chicago, Illinois 60637). *Phys. Rev. Lett.;* **35**: No. 19, 1272-1275(10 Nov 1975).

A theory of the orientation and alignment of atoms observed upon emergence from tilted foils is presented. The interaction with the foil surface is taken into account in the production process of particular states. Once they are produced, the evolution of these states, under the influence of the residual field near the surface, is calculated in the fashion introduced by Eck. The most general effect of this evolution is presented. (AIP)

9567 L-shell x-ray production cross sections for light ions on Sm, Yb, and Pb. Gray, T.J.; Light, G.M.; Gardner, R.K.; McDaniel, F.D. (Regional Nuclear Physics Laboratory, Department of Physics, North Texas State University, Denton, Texas 76203). *Phys. Rev., A;* **12**: No. 6, 2393-2398(Dec 1975).

L-shell x-ray production cross sections for the Ll, $L\alpha_{1,2}$, $L\gamma_1$, and $L\gamma_{2,3,6}$have been measured for ^1H, ^4He, and ^7Li on Yb and Pb and for ^4He and ^7Li on Sm. The energy ranges for the incident-ion species were 0.3 to 2.4 MeV/amu for ^1H, 0.15 to 4.4 MeV/amu for ^4He, and 0.9 to 3.0 MeV/amu for ^7Li. Comparisons of the $L\alpha_{1,2}$, $L\gamma_1$, and $L\gamma_{2,3,6}$x-ray production cross-section data have been made to the predictions of the plane-wave Born approximation (PWBA) and the PWBA with corrections for Coulomb deflection and/or binding-energy effects. The comparisons show that for the individual x-ray production cross sections, there are problems associated with the binding-energy correction calculations for the $L\gamma_1$ and $L\gamma_{2,3}$ x-ray data. Furthermore, measurements of the ratio of $L\alpha_{1,2}$ to $L\gamma_{2,3}$ x-ray intensities do not support the use of an increased effective binding energy in the PWBA formulation. (AIP)

9568 Reactions of modulated molecular beams with pyrolytic graphite. III. Hydrogen. Balooch, M.; Olander, D.R. (Materials Research Division, Lawrence Berkeley Laboratory and the Depart-

ment of Nuclear Engineering, University of California, Berkeley, California 94720). *J. Chem. Phys.*; **63**: No. 11, 4772-4786(1 Dec 1975).

The reaction of hydrogen and pyrolytic graphite was studied by modulated molecular beam—mass spectrometric methods. Because molecular hydrogen does not react with graphite (within the detection limits of the technique), an atomic hydrogen reactant beam was generated by thermal dissociation of H_2 in an effusion oven. For surface temperatures up to 800 degreeK, methane was the sole product. Acetylene was observed at temperatures above 1000 degreeK. Between 800 and 1000 degreeK, no carbon gasification occured; the surface acted only to recombine H atoms to form H_2. The data were analyzed in terms of a model in which methane is formed by sequential addition of H atoms to CH/subn/ (n=0,1,2,3) and acetylene is formed by surface combination of two CH groups. The agreement between the model and the molecular beam data is very good. The model also predicts previous high pressure (1 atm H_2) carbon gasification rates determined in conventional kinetic experiments. (AIP)

9569 Theory of final-state coherence in beam: tilted-foil interactions. Herman, R.M. (Department of Physics, The Pennsylvania State University, University Park, Pennsylvania 16802). *Phys. Rev. Lett.*; **35**: No. 24, 1626-1629(15 Dec 1975).

I propose a theory for the orientation and alignment of atomic states following atomic-beam passage through foils tilted through angle α from normal incidence. The final encounters within the foil operate on the existing foil-induced alignment, producing orientation and altered alignment. Within theoretical limitation, tensorial components transforming as angular momentum components in the collision frame vary as $\tan\alpha$, while those associated with the squares of components contain a $\tan^2\alpha$ dependence, in substantial agreement with observation. (AIP)

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 9585, 9590, 9844, 9868, 9891, 10038

9570 (ITP—75-62R) **Doublets of alpha-oxygen. II. Experiment.** Gaididei, Yu.B.; Loktev, V.M.; Prikhot'ko, A.F.; Shanskii, L.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 24p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The experimental results of the investigations of biexciton absorption α-O_2 performed at the temperature near 1°K are presented. The interpretation of a doublet structure of the absorption observed is suggested using the theory developed in I. The effect of resonance interactions in the formation processes of biomolecular electron-vibrational series and the role of the collective excited states of a crystal are discussed.

9571 (LBL—3858) **Hyperfine quenching of the 2^3P_0 state in heliumlike ions.** Mohr, P.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 19 Nov 1975. Contract W-7405-Eng-48. 7p. (CONF-750975—12). Dep. NTIS $4.50.

From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

An estimate is presented of the lifetime of the 2^3P_0 state for odd-Z heliumlike ions in the range Z = 9 to 29. An approximation scheme is employed which utilizes the fact that both Z^{-1} and $(Z\alpha)^2$ are small parameters for the range of Z under consideration. 1 fig, 2 tables, 14 refs. (GHT)

9572 (ORO—3346-173, pp 25-29) **X-ray and electron spectroscopy with radioactive sources.** 31 Oct 1975.

In Nuclear and x-ray spectroscopy with radioactive sources. Eleventh annual progress report, February 1, 1975—January 31, 1976.

Preliminary work on L_1-subshell x-ray fluorescence and Coster—Kronig yields, and measurements of mean L-fluorescence yields from double vacancy states in indium is reported. (SDF)

9573 Hyperfine structure of 15-d ^{205}Bi and isotope shift from ^{209}Bi. Marino, C.A. New York; New York University (1975). 125p. University Microfilms Order No. 75-22,909.

Thesis (Ph. D.).

The hfs of 15-d ^{205}Bi($I = 9/2$) was measured in the spectrum of the $6p^27s\ ^4P/sub\ 1/2/$-$6p^3\ ^4S/sub\ 3/2/$ 3067-A line. Some 10^{15} ^{205}Bi atoms were produced with the Princeton University cyclotron, mainly in a ^{207}Pb(p,3n)^{205}Bi reaction; the target was natural lead. After chemical separation, the ^{205}Bi fraction was enriched in the Argonne National Laboratory mass separator. Electrodeless lamps, containing approximately 10^{13} atoms, were prepared, and spectra were recorded photographically with the use of a 25-cm blazed diffraction grating, used in autocollimation near 63°, and mounted in a 10-m focal length Czerny-Turner monochromator. Measurements were made of the positions of the F = 6 yields 6 (100 percent), F = 5 yields 5 (51 percent), F = 4 yields 5 (34 percent) and the center of gravity of the F = 4 yields 4 (51 percent) and the F = 4 yields 3 (54 percent) ^{205}Bi components relative to the F = 5 yields 5 (51 percent) ^{209}Bi component (relative intensities in parentheses). The hyperfine interval between the F = 5 yields 5 and the F = 4 yields 5 components was used to obtain $^{205}A(\ ^4P/sub\ 1/2/) = 166(4)$ mK. Neglecting hfs anomalies, this gives $^{205}A(\ ^4S/sub\ 3/2/) = -15.1(4)$ mK. for the magnetic-dipole interaction constant, or a magnetic dipole moment $\mu(^{205}Bi) = 4.13(11)$ n.m. Calculations of the magnetic-dipole moment, which include configuration mixing and pion exchange contributions are substantially in agreement with this value. The hfs interval between the F = 5 yields 5 and the F = 5 yields 6 components could be used to obtain only a rough estimate for the electric-quadrupole interaction constant $^{205}B(\ ^4S/sub\ 3/2/)$ approximately equal to −2. +- 18. mK. The ^{205}Bi-^{209}Bi isotope shift is = 190(23) mK, with ^{205}Bi at the lower wave number. (Diss. Abstr. Int., B)

9574 1/Z-expansion study of the $1s^22s^2\ ^1S$, $1s^22s2p\ ^1P$, and $1s^22p^2\ ^1S$ states of the beryllium isoelectronic sequence. Watson, D.K.; O'Neil, S.V. (Harvard Coll. Observatory, Cambridge). *Phys. Rev., A;* **12**: No. 3, 729-735(Sep 1975).

A Z-expansion procedure is used to obtain eigenvalues and eigenfunctions for the $1s^22s^2\ ^1S$, $1s^22p^2\ ^1S$, and $1s^22s2p\ ^1P$ states of the beryllium isoelectronic sequence. The degeneracy effects associated with the $1s^22s^2\ ^1S$ and the $1s^22p^2\ ^1S$ states are included to every order in the perturbative procedure. Z expansions of the dipole length and dipole velocity forms of the oscillator strength for the $1s^22s^2\ ^1S$-$1s^22s2p\ ^1P$ and $1s^22s2p\ ^1P$-$1s^22p^2\ ^1S$ transitions are compared with the results of calculations using individual values of the nuclear charge Z. (auth)

9575 Seventh spectrum of tungsten (W VII); resonance lines of HF v. Sugar, J.; Kaufman, V. (National Bureau of Standards, Washington, DC). *Phys. Rev., A;* **12**: No. 3, 994-1012(Sep 1975).

Observations of W VII were carried out in the spectral range 100 to 2000 A utilizing normal- and grazing-incidence spectrographs. The light source was a sliding spark operated at peak currents of 1000 to 3000 A. Eighty-five energy levels of $4f^{13}$nl and $5p^5$nl configurations were deduced for nl = 5d, 6s, 6p, 6d, and 7s. These are based on the classification of 310 lines in the range 130 to 1436 A. Calculations of all observed configurations were carried out with configuration interaction (CI) for the purpose of fitting radial integrals and confirming the analysis. The stong CI between p^5nl and f^{13}nl configurations where nl = 5d, 6p, 6d provided well-defined CI integrals in good agreement with Hartree—Fock values. A value of 984,100 +- 500 cm^{-1} was derived for the ionization energy from the $4f^{13}$ns series. The resonance lines of Hfv for $5p^6$-$5p^55d,6s$ are given. A revised value for the ionization energy of W VI is given. (auth)

9576 Ionization energies of hydrogenlike atoms in intense electromagnetic fields. O'Connell, R.F. (Louisiana State Univ., Baton Rouge). *Phys. Rev., A;* **12**: No. 3, 1132-1134(Sep 1975).

An analytic expression is derived for the energy spectrum of hydrogenlike atoms in an intense radiation field, which is valid up to intensities for which R_0 much less than a Bohr radius, where R_0 is the amplitude of the classical displacement of a free electron in the radiation field. (auth)

9577 Kinetics of He(2 ^{1}S) using resonance ionization spectroscopy. Payne, M.G.; Hurst, G.S.; Nayfeh, M.H.; Judish, J.P.; Chen, C.H.; Wagner, E.B.; Young, J.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.*; **35**: No. 17, 1154-1156(27 Oct 1975).

We have demonstrated that quantum selected populations of He(2^1S) can be converted completely to ionization by single-photon excitation to He(3^1P) followed by collision-induced associative ionization. For helium pressures between 15 and 100 Torr, saturation of ionization was observed whenever a tunable dye laser produced more than 0.1 J/pulse. Absolute numbers of He(2^1S) per ion pair formed from proton interaction and the decay rates of He(2^1S) support a recent energy-pathways model. (AIP)

9578 Nature of excited helium atoms in liquid helium: a theoretical model. Hickman, A.P.; Steets, W.; Lane, N.F. (Rice Univ., Houston, TX). *Phys. Rev., B;* **12**: No. 9, 3705-3717(1 Nov 1975).

A model is developed in which excited helium atoms in liquid helium may exist in stable cavities of diameter 10 A and larger. A repulsive effective interaction between the excited atom and the remaining atoms in the ground state is responsible for cavity formation. The equilibrium shape of the cavity is determined by minimizing the total energy, which is the sum of the electronic perturbation due to the surrounding liquid and the energy required to form the cavity. Each of these can be evaluated

separately as a function of the cavity size and shape. The energy required to form a near-spherical cavity of radius R is approximated by the classical expressions for work done against the surface tension γ of liquid helium, and against the external pressure p on the liquid. For a particular cavity size, the liquid may be represented by a perturbing potential, and the response of the electronic wave function explicitly determined using the variational method. The calculations indicate that the optical spectra of helium atoms in these cavities are only slightly perturbed, and agreement with observed spectra lends strong support to the cavity model. Agreement has been obtained with the observed emission transitions 2^3P yields 2^3S and $3^1\,^3S$ yields $2^1\,^3P$, and also with the absorption 2^3S yields 2^3P, at saturated vapor pressure. Recently, the pressure dependence of the position and width of these spectral lines has been measured up to 25 atm. The pressure dependence predicted by the model is in good agreement with the data for all lines in which the initial state is spherically symmetric. (auth)

9579 **Molecular structue of XeF_6.** Pitzer, K.S.; Bernstein, L.S. (Univ. of California, Berkeley). *J. Chem. Phys.;* **63**: No. 9, 3849-3856(1 Nov 1975).

The full array of structure-related experimental data for XeF_6 is considered simultaneously. Electron diffraction, infrared, Raman and ultraviolet spectra, electric field deflection of molecular beam, and calorimetrically determined entropy data are all found to be consistent with a structural model involving substantial distortion in the T/sub 1u/ bending mode from octahedral symmetry and a pseudorotation in two dimensions of this distortion. Several other vibration frequencies are assigned, and the mean value of three unobserved frequencies is determined from the entropy. No quantitative value could be given for the potential restricting pseudorotation, but various arguments agree in indicating that it is small. There is no reason to question previous proposals that this peculiar structure arises from a pseudo-Jahn-Teller effect associated with the relatively low energy of excitation of a xenon 5s electron to the 5p level. (auth)

9580 **Hydrogen 1S-2S isotope shift and 1S Lamb shift by laser spectroscopy.** Lee, S.A.; Wallenstein, R.; Hansch, T.W. (Department of Physics, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.;* **35**: No. 19, 1262-1266(10 Nov 1975).

We measured the isotope shift of the 1S-2S transition in atomic hydrogen and deuterium to be 670.933plus-or-minus0.056 GHz, using Doppler-free two-photon spectroscopy with a frequency-doubled, pulsed, dye laser. The Balmer-β line is simultaneously observed in saturated absorption with the fundamental dye-laser output. A comparison of the intervals 1S-2S and $2P_{3/2}$-$4D_{3/2}$ determines the Lamb shift of the 1S ground state to be 8.20plus-or-minus0.10 GHz (H) and 8.25plus-or-minus0.11 GHz (D), in agreement with the theoretical values. (AIP)

COLLISION PHENOMENA

9581 (COO—1106-1) **Theoretical research on charge exchange of uranum ions at thermal energies.** Bardsley, J.N. (Colorado Univ., Boulder (USA); Pittsburgh Univ., Pa. (USA). Dept. of Physics). 1975. Contract E(04-3)-1106. 13p. Dep. NTIS $3.50.

The cross section for resonant charge transfer in U^+-U collisions is calculated as a function of the energy in the center-of-mass coordinate frame. The computed value decreases monotonically from approximately 300 A^2 at 0.025 eV to 100 A^2 at 50 eV. The latter value would be appropriate for ions of energy 100 eV moving through a gas of neutral atoms at thermal velocities. (auth)

9582 (ITP—75-69R) **Basis calculation of the short-ranged interactions in the theory of ion systems.** Holovko, M.F.; Pizio, O.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 23p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The idea of the basis calculation of the short-ranged interactions for the construction of statistical theory is developed. A many-sort system is considered. The virial expansions for the free energy and distribution functions are obtained. The screened potentials are investigated. The contact values of the pair distribution functions for the simplest model of the electrolyte are obtained. (auth)

9583 (ORNL—5046, pp 103-113) **Atomic and molecular physics.** Anderson, V.E.; Cox, J.T.; Huynh, Q.A. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics covered include: electron attachment to SO_2 in high pressure gases; long-lived parent negative ions formed via nuclear-excited Feshbach resonances, part IV, a systematic study of NO_2-containing benzene derivatives; threshold-electron excitation and compound-negative-ion states of aromatic hydrocarbons; linking of existing data on electron-molecule interactions in gases with those in the liquid phase; slowing down of subexcitation electrons in polyatomic gases; electron mobilities in high-pressure gases ("quasi-liquids"); measurement of the mobility of excess electrons in liquids; potential energy function of an excess electron in a nonpolar liquid; electron mobilities in gases and liquids; photophysics of aromatic hydrocarbons; synthesis of electron-molecule interactions with benzene and benzene derivatives; and spin-off of basic studies on electron attachment to, and elastic scattering from, polyatomic molecules. 14 figures, 2 tables. (GHT)

9584 (ORNL—5046, pp 157-173) **Chemical physics studies.** Compton, R.N.; Callcott, T.A.; Carter, A. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics covered include: negative ion formation in organic molecules; negative-ion formation in $Fe(CO)_5$ and $Ni(CO)_4$; collisional ionization of Na, K, and Cs by CO_2, COS, and CS_2, electron affinities; abnormally large electron affinities for some hexafluoride molecules; π-electron affinities for organic molecules; gas phase laser-ion spectroscopy; studies of dissociative ionization by electron impact; ionization potentials of organic donor molecules; reactions of electronically excited atoms; kinetic energy production from unimolecular dissociations; optical and electrical measurements on organic semiconductors; level shifts from coulomb interaction of atoms in a gas; and rotational resonance in low-energy electron-H_2 scattering. 24 figures, 3 tables. (GHT)

9585 (ORNL—5046, pp 174-196) **Atomic physics and laser research.** Hurst, G.S.; Payne, M.G.; Chen, C.H. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics covered include: resonance ionization spectroscopy; energy pathways and Jesse effects in helium; energy transfer; laser applications; and analytical applications. (GHT)

9586 **Rotational excitation of linear triatomic molecules: Ar, Kr + N_2O, CO_2.** Farrar, J.M.; Parson, J.M.; Lee, Y.T. (Univ. of Chicago). pp 214-227 of In Proceedings of the fourth international symposium on molecular beams. Chicago; University of Chicago (1973).

From 4. international symposium on molecular beams; Cannes, France (9 Jul 1973).

Rotational excitation of N_2O and CO_2 in collisions with Ar and Kr was studied by crossing two supersonic molecular beams and detecting scattered products with a mass spectrometer. Measurement of the time-of-flight spectrum of the products as a function of laboratory scattering angle THETA indicates that the inelasticity is concentrated in the forward direction in the center-of-mass system. Differences between CO_2 and N_2O are discussed briefly. 6 figures. (auth)

9587 **Model study of collision induced dissociation of a diatomic molecule by an atom.** Ford, L.W. (Purdue Univ., Lafayette, IN); Diestler, D.J.; Wagner, A.F. *J. Chem. Phys.;* **63**: No. 5, 2019-2034(1 Sep 1975).

The time-dependent Schroedinger equation for the collinear collision of an atom with a diatomic molecule is solved numerically after the manner of McCullough and Wyatt. The binding potential is taken to be a truncated square well and the interaction is impulsive (hard sphere). For the case in which all three masses are equal final relative momentum distributions and dissociation probabilities are obtained as a function of both the initial relative kinetic energy and the initial vibrational level. For purposes of comparison quasiclassical trajectory analyses of the same cases were performed. Quantum effects on collision-induced dissociation (CID) are seen to be important for this model. A very notable characteristic of the model, observed in both the quantum and classical results, yet not in most experimental results, is that CID is severely vibrationally inhibited, i.e., the probability of CID decreases as the initial vibrational quantum number increases at a fixed total collision energy. Probable causes of this strong vibrational inhibition are examined classically by a detailed trajectory analysis. It is concluded that the collinearity of the model is most likely responsible. (auth)

9588 **Energy distribution of secondary electrons.** Kim, Y.K. (Argonne National Lab., IL). *Radiat. Res.;* **64**: No. 1, 96-105(Oct 1975).

A simple method for constructing a consistent set of secondary-electron spectra from related theoretical and experimental data is reviewed. The method enables one to extend the spectra to the range of variables (e.g., primary and secondary-electron energies) not covered by experimentation. As an illustration, recommended spectra for electron impact on He and N_2 are presented. For incident protons of moderate energy (less than 300 keV) charge transfer to the hydrogen continuum accounts for a substan-

tial fraction (less than 25 percent) of the total ionization cross section. Suggestions are given for desirable experiments that would be useful in determining reliable secondary-electron spectra. (auth)

9589 Role of secondary electrons in charged particles degradation. Green, A.E.S. (Univ. of Florida, Gainesville). *Radiat. Res.*; **64**: No. 1, 119-140(Oct 1975).

A fundamental description of charged particle deposition phenomena must include detailed characterizations of the production and interactions of secondary electrons which arise along the track of a primary particle. Since these secondary electrons predominately have energies below that describable by the Born approximation, one must go beyond the Bethe theory of stopping power and adopt a detailed microscopic approach. In this paper, work since 1963 involving secondary electron distributions is reviewed, beginning with the work of Green and Barth, largely in relation to applications but also in relation to the fitting of experimental data and the testing of theoretical models. In the latter context, the independent particle model of Green, Sellin, and Zachor in Born approximation and in the Eikonal approximations are utilized. (44 refs.) (auth)

9590 Energy distribution of secondary electrons. II. Normalization and extrapolation of experimental data. Kim, Y.K. (Argonne National Lab., IL). *Radiat. Res.*; **64**: No. 2, 205-216(Nov 1975).

A simple but powerful method of constructing a consistent set of energy distributions for secondary electrons produced by electron impact is presented. The method uses graphical presentations known as the Platzman and the Fano plots. Recommended energy distributions for He and N_2 are given for a wide range of primary-electron energies (50 to 100 keV). Data necessary for extrapolating the distribution to higher incident energy are also included. (auth)

9591 Vibrational excitation in benzene by electron impact via resonances: Selection rules. Wong, S.F.; Schulz, G.J. (Department of Engineering and Applied Science, Mason Laboratory, Yale University, New Haven, Connecticut 06520). *Phys. Rev. Lett.*; **35**: No. 21, 1429-1432(24 Nov 1975).

The vibrational excitation in the energy ranges of the lowest resonances in benzene has been measured and it is found that only few fundamental modes become excited. This selectivity of the excitation process can be understood in terms of selection rules which are based on symmetry considerations. The angular distribution of scattered electrons in the range of the lowest shape resonance (~1.2 eV) is consistent with an f/sub delta/ wave as the dominant partial wave. (AIP)

9592 Cross sections and threshold effects for electron-impact excitation of the $(2s^2)\ ^1S$ and $(2s2p)\ ^3P$ states of helium. Spence, D. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., A*; **12**: No. 6, 2353-2360(Dec 1975).

The energy and intensity of scattered electrons resulting from excitation of the $(2s^2)\ ^1S$ and $(2s2p)\ ^3P$ autoionizing states of helium have been measured as a function of incident electron energy. For incident energies only slightly higher than the threshold for $(2s^2)\ ^1S$ excitation, post-collision interactions between the scattered and ejected electrons cause the slowly moving scattered electron to lose an amount of energy proportional to $E^{-1.25}$/sub ex/ (where E/sub ex/ is the energy the scattered electron would have had in the absence of a post-collision interaction). This energy dependence compares well with an energy gain of the ejected electron proportional to $E^{-1.2}$/sub ex/, obtained by previous workers. Measurements of the intensity of scattered electrons show that both ^1S and ^3P total cross sections peak at threshold and have magnitudes about (2.0 and 4.0) x 10^{-20} cm^2, respectively, then rise to broad maxima of magnitudes about (2.5 and 5) x 10^{-20} cm^2 about 4.0 eV above their thresholds. A subsidiary peak at 59.0 eV in the ^3P cross section is attributed to decay of the previously unidentified $(2s2p^2)\ ^2S$ He^- state into the ^3P channel. The magnitude, energy, and width of this resonant structure in the ^3P channel agrees with theoretical predictions. (AIP)

9593 Pseudo-bound-state study of low-energy electron-molecule collisions: Elastic e—H_2 scattering. Morrison, M.A.; Lane, N.F. (Physics Department, Rice University, Houston, Texas 77001). *Phys. Rev., A*; **12**: No. 6, 2361-2368(Dec 1975).

A study of the low-energy elastic e-H_2 scattering information contained in multiconfiguration variational wave functions for a low-lying (positive) energy of the H_2^- system is described. The wave function is calculated using standard bound-state techniques, employing the modified valence-bond method with a basis set of Slater-type orbitals, and from it are obtained starting values at moderate electron-molecule separations for a simple single-channel scattering calculation, which is carried out beyond the region where exchange and coupling of partial waves are thought to be important. Results are presented for s/sub sigma/ elastic scattering for incident electron energies < or =μ10 eV in the static-exchange approximation with polarization included by means of an adiabatic polarization potential. The study shows that the standard H_2^- variational function does indeed provide a good approximation to the elastic scattering wave function in the region close to the molecule, but that care must be taken in choosing the basis set. Comparisons are made with other more traditional calculations. (AIP)

9594 Doppler shift of continuum x rays from heavy-ion collisions. Meyerhof, W.E.; Saylor, T.K.; Anholt, R. (Department of Physics, Stanford University, Stanford, California 94305). *Phys. Rev., A*; **12**: No. 6, 2641-2643(Dec 1975).

The continuum K x-ray spectrum from 200-MeV Kr + Zr has been found to undergo a Doppler shift with an effective Doppler velocity equal to (0.92 +- 0.03) v/sub ci/, where v/sub ci/ is equal to the center-of-mass velocity of the intermediate Kr + Zr molecule, corresponding to the incident projectile velocity. If the x rays are indeed generated by quasimolecular processes, the expected Doppler velocity is 0.90v/sub ci/, taking into account the slowing down of the projectile in the target. The anisotropy of the continuum spectrum in the c.m. system is derived. (AIP)

9595 The A+B/sub x/ condensation reaction: Crossed nozzle beams of Br_2 and (Cl_2)/sub x/ or (NH_3)/sub x/ clusters. Behrens, R. Jr.; Freedman, A.; Herm, R.R.; Parr, T.P. (Inorganic Materials Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley 94720). *J. Chem. Phys.*; **63**: No. 11, 4622-4631(1 Dec 1975).

Nozzle beams of Br_2 and Cl_2 or NH_3 have been crossed in a molecular beam scattering apparatus; the Cl_2 or NH_3 beam contained (Cl_2)/subx/ or (NH_3)/subx/ clusters distributed such that the intensity of a given cluster, F/subx/, decreased with increasing x for 1< or = x< or = approx. 50. Mass, angular, and time-of-flight spectra of the scattered neutral species all establish that the A+B/subx/yieldsAB/subx/* bimolecular condensation reaction is being observed. However, working from the data, it is not possible to distinguish between detection of a long-lived AB/subx/* metastable complex or of a decomposition product formed with low recoil velocity. Product angular distributions are confined to a small region of laboratory scattering angle Θ and peak at small but positive Θ (Θ=0degree and 90degree defined by cluster and Br_2 beam directions, respectively). It is pointed out that this sharp peaking at small Θ is due to a number of experimental factors, including a Jacobian factor varying as $\sin^{-2}\Theta$, and should be a universal characteristic of such condensation reactions in crossed beams. In the data it is indicated that there will be a high probability of fragmentation into small daughter ions upon electron bombardment (EB) ionization of an AB/subx/ or B/subx/ cluster for the range in x most sensitive to the measurements (~10< or = x< or =~50). This in turn implies that the concentration of neutral clusters in the beam can be seriously underestimated if the cluster ion mass spectra produced by EB ionization of the nozzle beam are assigned assuming that fragmentation is inconsequential. (AIP)

9596 Noncharacteristic radiations in atomic and molecular collisions. Chen, J.C.Y.; Ishihara, T.; Watson, K.M. (Department of Physics, University of California, San Diego, La Jolla, California 92037). *Phys. Rev. Lett.*; **35**: No. 23, 1574-1577(8 Dec 1975).

Noncharacteristic radiations in atomic and molecular collisions are examined. A new mechanism is considered in which electrons are induced to radiate collectively. The collective radiations are present even in the absence of inner-shell vacancies. The importance of this mechanism increases with collision energy and the number of electrons. The emitted photon energy increases with collision energy and can exceed the united-atom limit. The asymmetries of the noncharacteristic radiation are examined. (AIP)

9597 The dimensionality and choice of effective Hamiltonians for molecular collisions. Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). *J. Chem. Phys.*; **63**: No. 12, 5208-5215(15 Dec 1975).

The flexibility in choice of effective Hamiltonians is illustrated by considering various different dimensionality reducing procedures. Only a few members of the entire family of effective Hamiltonians have thus far been employed in actual computations. All the effective Hamiltonians are presented for two colliding molecules, and the reduced atom—molecule situation is also considered. The two-molecule case in body-fixed coordinates is treated in more detail since it has not been extensively examined before. Exactly analogous space-fixed and body-fixed dimensionality reductions are shown to be possible by appropriate selection and coupling of states. The available ranges of computing expense are discussed and the various methods related in these terms. Computing time and accuracy requirements are examined in re-

gard to choosing an effective Hamiltonian. Further avenues of pursuit and calculations are suggested by these considerations. (AIP)

ATOMIC AND MOLECULAR THEORY

REFER ALSO TO CITATION(S) 9584, 9891

9598 Threshold behavior of bound—bound and bound-free photoabsorption for the screened Coulomb potentials. Shore, B.W. (Univ. of California, Livermore). *J. Phys., B (London)*; **8**: No. 12, 2023-2040(1975).

Computations of bound—bound and bound—free transition strengths for a particle bound by a screened Coulomb (Debye) potential show that near the ionization limit transition strengths differ markedly from hydrogenic values: oscillator strengths of Rydberg series diminish more rapidly than the hydrogenic n^{-3} decrement and photoionization cross sections are zero at threshold. Sharp near-threshold photoionization resonances occur for appropriate Debye lengths. These effects are examined and illustrative computations are presented. (auth)

9599 Quasiclassical selection of initial coordinates and momenta for a rotating Morse oscillator. Porter, R.N. (State Univ. of New York, Stony Brook); Raff, L.M.; Miller, W.H. *J. Chem. Phys.*; **63**: No. 5, 2214-2218(1 Sep 1975).

The classical orbits of a rotating Morse oscillator are calculated by means of Hamilton—Jacoby theory after truncating the Hamiltonian to permit analytical solution. Except at very high J, the approximate analytic orbit for the radial coordinate is in good agreement with that obtained by numerical integration of the exact equations of motion. Bohr quantization gives an expression for the rotation-vibration energy correct through quadratic terms in $(v + {}^1/_2)$ and $J(J + 1)$, where v and J are the vibrational and rotational quantum numbers, respectively. The principal result is an analytic prescription for obtaining values of the coordinates and momenta, given v, J, and a set of random numbers, that facilitates properly weighted quasiclassical selection of initial states of diatomic molecules in trajectory calculations. (auth)

9600 Nature of secondary electrons created as the result of electron shake-off and vacancy cascades. Carlson, T.A. (Oak Ridge National Lab., TN). *Radiat. Res.*; **64**: No. 1, 53-69(Oct 1975).

Two sources of secondary electrons that are concomitant with most ionization phenomena and produce electrons in addition to the primary ionization event are: (1) electron shake-off and (2) vacancy cascades. Electron shake-off is the promotion of an electron into the continuum because of a sudden change in the central potential of an atom, caused, for example, by the loss of a shielding electron. A vacancy cascade is a series of Auger processes that ensue from the creation of a vacancy in the inner shell of an atom. A review of the nature of these sources of ionization and the energy and intensity distribution of secondary electrons that result from them is given. Suggestions are given for future experimental and theoretical developments. 25 refs (auth)

9601 Studies in molecular dynamics. XV. High temperature description of the transport coefficients. Alley, W.E.; Alder, B.J. (Univ. of California, Livermore). *J. Chem. Phys.*; **63**: No. 9, 3764-3768(1 Nov 1975).

The power series expansion of the transport coefficients in the attractive potential relative to the kinetic energy does not exist. However, the first term in this expansion appears to exist and is evaluated indirectly by molecular dynamics at various densities. For the diffusion coefficient this first term is predicted quantitatively at high density by the enhanced local density in the region of the attractive potential relative to that of the hard sphere system. Furthermore, since the enhanced density does not affect the kinetic contribution to the viscosity and thermal conductivity, these transport coefficients compare favorably with the predictions of the Boltzmann equation. An explicit calculation of the first term requires statistical mechanical averaging before expansion, a procedure unsuitable to molecular dynamics computations and which has as yet been unattained analytically at any finite density. (auth)

9602 Steric hindrance in the gas phase singlet electronic energy transfer: from naphthalene to the trans-azobutane isomers. Loper, G.L.; Lee, E.K.C. (Univ. of California, Irvine). *J. Chem. Phys.*; **63**: No. 9, 3779-3785(1 Nov 1975).

The singlet intermolecular energy transfer rates from naphthalene (S_1, ~91 kcal/mol) to the various trans-azobutane isomers have been measured in the gas phase. The first excited singlet states of these azobutane isomers lie below ~70 kcal/mol. The rate constants for singlet collisional energy transfer (k/sub c/) are 30.3 +- 2.6, 18.9 +- 0.9, 12.6 +- 1.0, and 3.2 +- 0.3 in units of 10^{10} $M^{-1}.sec^{-1}$, for the accepter series azo-n-butane, azoisobutane, azo-sec-butane, and azo-tert-butane, respectively. The tenfold decrease in the rates of energy transfer through this series have been attributed to increasing steric inhibition of the electron exchange contribution to singlet-singlet electronic energy transfer. (auth)

FLUID PHYSICS

GENERAL FLUID DYNAMICS

9603 (SAND—75-6100) **Thermodynamics and the propagation of shear-acceleration waves in incompressible viscoelastic fluids.** Nunziato, J.W.; Walsh, E.K. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 19p. (CONF-760404—1). Dep. NTIS $3.50.

From 8. southeastern conference on theoretical and applied mechanics; Blacksburg, Virginia, United States of America "USA" (Apr 1976).

A formulation for the constitutive theory of incompressible viscoelastic fluids is described which is an alternative to the usual formulation in terms of a relative strain history. The formulation discussed here considerably simplifies matters and yet retains the present configuration as the reference configuration; in this way the formulation is suitable for flow problems. In particular, the general thermodynamic theory of heat-conducting fluids is considered, and it is shown that the constitutive equations can be written in terms of summed histories. The use of these histories results in simple differential forms; the consequences of the Second Law can therefore be derived in a more direct and concise fashion. The general propagation condition governing shear-acceleration waves and some related results are also derived. (RWR)

9604 (UCID—17013) **BBC hydrodynamics.** Sutcliffe, W.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1974. Contract W-7405-Eng-48. 44p. Dep. NTIS $4.00.

Calculations of two-dimensional multifluid Eulerian hydrodynamics in BBC are discussed; hydro routines in the FORTRAN code BBC make extensive use of vectors. Calculations are performed with either cylindrical- or slab-type symmetry. The problem grid is bounded by a rectangular band of empty boundary zones. The interfaces between the regular and boundary zones can be selected to be either rigid or vacuum interfaces. The set up for BBC problems is described in the KEG manual [UCIR-646]. A hydro cycle consists of four one-dimensional sub-cycles (or passes) that include the Lagrangian and advection calculations. (RWR)

9605 (ORNL-tr—4059) **Statistical models in turbulence theory.** Novikov, E.A. [nd]. Translation by M. Gerrard of Statisticheskie modeli v teorii turbulentnosti, Akademiya Nauk SSSR, Moscow, 1969. 9p. Dep. NTIS $4.25.

Similarity considerations are used, but basic effort is directed toward obtaining results which cannot be described by one of the dimension relations. A model is used based on the Navier—Stokes equations having a purely statistical nature. The similarity concept itself is somewhat broadened—a scale similarity is introduced. Problems describing turbulent flow in terms of the characteristic functional and finite measured distributions are also considered. (auth)

9606 (UCRL-Trans—10995) **Numerical solution of the problem of shock-wave diffraction on a wedge.** Lipnitskii, Yu.M.; Lyakhov, V.N. Translated from *Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza;* No. 6, 88-93(1974). 14p. Dep. NTIS $3.50.

The problem has been formulated for a complete system of equations of gas dynamics in self-similar variables in earlier work [NYO-9764], and a method of solution was put forward. An analogous formulation of the problem is given in the present work; however, for the computation of discontinuous flows the method of straight-through calculation without isolating densification jumps in the flow field was used. In this case the shock waves and contact discontinuities are regions with sharp changes in the gas-dynamic parameters. The calculations were done for a broad range of interaction angles and shock-wave intensities. The results obtained are in good agreement with analytic solutions and with experimental data. In the course of the solution information on an additional increase of the reflection pressure after the Mach foot was obtained. 6 figures. (RWR)

9607 (BNL-tr—614) **Finite-amplitude waves in a superconducting coaxial line.** Kiselev, M.I. Translated by S.J. Amoretty from *Zh. Tekh. Fiz.*; **45**: No. 2, 382-385(1975). 9p. Dep. NTIS $4.50.

The propagation of deformations and perturbations of the magnetic field in a superconducting transmission line consisting of a coaxial system of elastic conductors cooled by streams of cryogenic liquid is treated in the hydrodynamic approximation. (auth)

MAGNETOHYDRODYNAMICS

9608 (CONF-750335—53) **Transport of dc and bunched beams through a 25 MV folded tandem accelerator.** Milner, W.T.; Alton, G.D.; Hensley, D.C.; Jones, C.M.; King, R.F.; Larson, J.D.; Moak, C.D.; Sayer, R.O. (Oak Ridge National Lab., Tenn. (USA)). 1975. 5p. Dep. NTIS $4.00.

From Particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Studies of beam transport through the planned ORNL 25 MV folded tandem accelerator demonstrate efficient utilization of phase-space acceptance and the feasibility of injecting bunched beams from the tandem accelerator into the Oak Ridge Isochronous Cyclotron (ORIC). Use of a 180° bending magnet in the terminal provides outstanding charge state selection and permits better control of the high-energy beam transport than has previously been possible in conventional tandem accelerators. Time spreads introduced in bunched beams by the 180° magnet are kept within a 6° RF acceptance window at ORIC provided the beam has a crossover in the center of the 180° magnet. Ion masses from 12 to 240 amu, preinjection energies from 150 to 500 keV and terminal voltages from 7.5 to 25 MV were studied for dc beams and beams bunched by various modulation techniques. (auth)

9609 (TID—3356) **Magnetohydrodynamics power generation and theory. A bibliography.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Nov 1975. 875p. Dep. NTIS $13.60.

A major portion of the scientific and technical information published on this subject since 1957 has been cataloged, indexed, and stored in machine-readable form. The compilation includes 8539 citations of foreign and domestic research reports, journal articles, patents, conference proceedings, and books. The references are arranged in broad categories and are made up of complete bibliographic citations. (BJG)

ELECTROHYDRODYNAMICS

REFER ALSO TO CITATION(S) 9609

9610 (CONF-750335—51) **Design of the Zero Gradient Synchrotron booster II ring magnet.** Foss, M.H.; Thompson, K.; Lari, R.J.; Simpson, J. (Argonne National Lab., Ill. (USA)). 12 Mar 1975. Contract W-31-109-Eng-38. 5p. Dep. NTIS $4.00.

From Particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The booster program was undertaken at the Argonne National Laboratory Zero Gradient Synchrotron (ZGS) to increase the ZGS beam intensity. By using the transplanted Cornell University 2.2 GeV synchrotron as Booster I, it has been shown at the ZGS that more than one hundred turns of H^- ions can be injected and stripped to H^+ in a booster ring. In Booster II, this intense beam can be accelerated to 500 MeV. Several pulses from the booster, which can run at 60 Hz, will make one ZGS pulse. The Booster II ring magnet, now under construction, is described. (auth)

9611 **Continuum dielectric model for an electron in a nonpolar fluid.** Baird, J.K. (Oak Ridge National Lab., TN). *J. Phys. Chem.;* **79**: No. 26, 2862-2866(18 Dec 1975).

A function expressing the electrostatic polarization energy experienced by an electron immersed in a nonpolar fluid is derived on the basis of classical electrostatics. A continuum dielectric model is used to represent the collective effect of the fluid molecules, which are assumed individually to possess spherical symmetry. The local electric field in the fluid is calculated from the sum of a cavity field and a dielectric reaction field. The model is parametrized by constants (the molecular electric dipole and quadrupole polarizabilities and the effective cavity radius presented by a molecule in the fluid), which for the example of argon can be determined from published literature data. The results obtained from the continuum model are compared with a recent theory dealing with the same question, but based on a model in which the molecules in the fluid are regarded as being discrete, and the local electric field is taken to be the traditional one due to Lorentz. (auth)

SUPERFLUIDITY

REFER ALSO TO CITATION(S) 10018

9612 **Relaxation of the wall-pinned magnetization ringing mode in superfluid ^{3}He-B.** Webb, R.A.; Sager, R.E.; Wheatley, J.C. (Department of Physics, University of California at San Diego, La Jolla, California 92037). *Phys. Rev. Lett.;* **35**: No. 17, 1164-1166(27 Oct 1975).

Observations of the wall-pinned mode in ^{3}He-B allow new magnetic relaxation phenomena to be studied. Excepting the quantitative value of the zero-time ringing frequency, comparison of experiment with theory is satisfactory, including a linear dependence of the square of the ringing period on time and a square-root singularity near T/sub c/ in the relaxation parameter. (AIP)

9613 **Superfluid density in porous Vycor glass.** Kiewiet, C.W.; Hall, H.E.; Reppy, J.D. (Physics Department, Schuster Laboratory, The University, Manchester M13 9PL, England). *Phys. Rev. Lett.;* **35**: No. 19, 1286-1289(10 Nov 1975).

The superfluid density of ^{4}He confined to porous Vycor glass has been determined from fourth-sound measurements over a temperature range from below 0.1 K to within 10 mK of the transition. For temperatures below 1.4 K the normal-fluid fraction can be described in terms of a roton contribution with gap Δ/k/subB/ =5.85 K and a "one-dimensional," T^2, phonon contribution. Near the transition temperature, T/subc/=1.955 K, the superfluid density is found to vary as (T/subc/-T)/sup zeta/ with zeta=0.65plus-orminus0.03. (AIP)

9614 **Relaxation-time approximation for sound attenuation in superfluid ^{3}He.** Combescot, R. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). *Phys. Rev., B;* **12**: No. 11, 4839-4846(1 Dec 1975).

The sound attenuation due to collisions in superfluid ^{3}He is studied, using for the collision integral a simplifying ansatz which satisfies conservation laws. In the zero-sound regime, attenuation and velocity are fairly frequency independent; this supports the idea that collisions can be accounted by a mere background in sound attenuation. In the first-sound regime, the viscosity tensor is studied (in the A phase) and its low-temperature behavior investigated. (AIP)

9615 **Second-sound attenuation in a supercritical counterflow jet.** Laguna, G.A. (California Institute of Technology, Pasadena, California 91109). *Phys. Rev., B;* **12**: No. 11, 4874-4881(1 Dec 1975).

The attenuation of a beam of high-frequency second sound traversing a counterflow jet in liquid helium has been measured in the temperature range 1.6—2.06 degree K. Combined use of thin-film superconducting thermometers with specially developed low-noise amplifiers allowed resolution of the second-sound amplitude to better than one part in 10^8 degree K. The additional attenuation due to the jet was found to be less than 10% of the predicted value using the theory of mutual friction in a supercritical counterflow, and consistent with the result of earlier temperature-gradient and ion-beam attenuation measurements. (AIP)

9616 **Orbital waves in the A phase of superfluid ^{3}He.** Combescot, R. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). *Phys. Rev. Lett.;* **35**: No. 24, 1646-1649(15 Dec 1975).

Orbital waves in the A phase of superfluid ^{3}He are shown to be essentially diffusive. The weak-coupling expression for the "angular superfluid density" tensor C is obtained. (AIP)

9617 **Vortex velocity in turbulent He II counterflow.** Ashton, R.A.; Northby, J.A. (Department of Physics, University of Rhode Island, Kingston, Rhode Island 02881). *Phys. Rev. Lett.;* **35**: No. 25, 1714-1717(22 Dec 1975).

The ion-vortex interaction has been used to measure the drift velocity of the vorticity present in turbulent counterflow, and find that it moves in the direction of normal-fluid flow. The result is in direct conflict with a central assumption of the presently accepted model of the turbulent state. (AIP)

9618 **Fluctuations above the superfluid transition in liquid ^{3}He.** Emery, V.J. (Brookhaven National Lab., Upton, NY). *J. Low Temp. Phys.;* **22**: No. 3/4, 467-478(Feb 1976).

It is shown that fluctuations above the superfluid transition in liquid ^{3}He depend strongly upon the relative angular momentum l for which Cooper pairing occurs. The effects may be calculated for any value of l and they should be observable in the static magnetization, viscosity, and spin diffusion coefficient, giving a means of determining l. Conclusions to be drawn from existing experiments are discussed. (auth)

HIGH ENERGY PHYSICS

9619 High-energy physics. Malamud, E.; Nezrick, F. (Fermi National Accelerator Laboratory). *Phys. Today;* **28**: No. 11, 25-35(Nov 1975).

Sharing of accelerators and technologies has led to joint studies involving interactions of pions, protons and neutrinos. (AIP)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 9679

9620 Electron—positron annihilation and the structure of hadrons. Gilman, F.J. (Stanford Univ., CA). pp 29-69 of In Theories and experiments in high-energy physics. Kursunoglu, B. (ed.). New York; Plenum Publishing Corp. ([nd]).

A review is given of knowledge of the total cross section for e^+e^- yields hadrons. Particular emphasis is put on scaling and the excitation of new hadronic degrees of freedom. Present information on the psi's then reviewed in a phenomenological vein, from which one turns to a possible theoretical understanding of the new discoveries in terms of a new hadronic quantum number, a concrete example of which is charm. (JFP)

9621 Electron scattering at 4° with energies of 4.5—20 GeV. Stein, S.; Atwood, W.B.; Bloom, E.D.; Cottrell, R.L.A.; DeStaebler, H.; Jordan, C.L.; Piel, H.G.; Prescott, C.Y.; Siemann, R.; Taylor, R.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 7, 1884-1919(1 Oct 1975).

This paper presents the results of the analysis of a single-arm inelastic-electron-scattering experiment at an angle of 4°. We present data on the turn on of scaling in the low-q^2 region $0.1 < q^2 < 1.8$, the neutron—proton comparison at large values of the scaling variable ω, resonance excitation, and the shadowing in scattering from heavy nuclei. (AIP)

9622 Quantum numbers and decay widths of the psi (3684). Luth, V.; Boyarski, A.M.; Lynch, H.L.; Breidenbach, M.; Bulos, F.; Feldman, G.J.; Fryberger, D.; Hanson, G.; Hartill, D.L.; Jean-Marie, B.; Larsen, R.R.; Luke, D.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Pun, T.P.; Rapidis, P.; Richter, B.; Schwitters, R.F.; Tanenbaum, W.; Vannucci, F.; Abrams, G.S.; Chinowsky, W.; Friedberg, C.E.; Goldhaber, G.; Kadyk, J.A.; Litke, A.M.; Lulu, B.A.; Pierre, F.M.; Sadoulet, B.; Trilling, G.H.; Whitaker, J.S.; Winkelmann, F.C.; Wiss, J.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.;* **35**: No. 17, 1124-1126(27 Oct 1975).

Cross sections for e^+e^-yieldshadrons, e^+e^-, and $\mu^+\mu^-$ near 3684 MeV are presented. The psi(3684) resonance is established as having the assignment J/sup PC/=1^{--}. The mass is 3684+-5 MeV. The partial width for decay to electrons is Γ/sube/=2.1+-0.3 keV and the total width is Γ=228+-56 keV. (AIP)

9623 Electroproduction of single pions with large transverse momenta. Browman, A.; Hanson, K.M.; Holmes, S.D.; Kline, R.V.; Larson, D.; Pipkin, F.M.; Raither, S.W.; Silverman, A. (Laboratory for Nuclear Studies, Cornell University, Ithaca, New York 14850). *Phys. Rev. Lett.;* **35**: No. 20, 1313-1316(17 Nov 1975).

We report measurements of the electroproduction reaction epyieldseπ^+n for pions produced between 60 and 90° in the virtual-photon—proton center-of-mass system. The cross section is studied as a function of the center-of-mass energy, W, and the square of the virtual-photon mass, $-Q^2$, in the region 1.2 GeV < or = W < or = 3.0 GeV, 1.2 GeV^2 < or = Q^2 < or = 4.4 GeV^2. The data show a strong W dependence in accord with simple quark-model predictions, but exhibit a Q^2 dependence which is difficult to explain in the context of such a model. (AIP)

9624 Azimuthal asymmetry in inclusive hadron production by e^+e^- annihilation. Schwitters, R.F.; Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Feldman, G.J.; Hanson, G.; Hartill, D.L.; Jean-Marie, B.; Larsen, R.R.; Luke, D.; Luth, V.; Lynch, H.L.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Pun, T.P.; Rapidis, P.; Richter, B.; Tanenbaum, W.; Vannucci, F.; Pierre, F.M.; Abrams, G.S.; Chinowsky, W.; Friedberg, C.E.; Goldhaber, G.; Kadyk, J.A.; Litke, A.M.; Lulu, B.A.; Sadoulet, B.; Trilling, G.H.; Whitaker, J.S.; Winkelmann, F.C.; Wiss, J.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.;* **35**: No. 20, 1320-1322(17 Nov 1975).

We have observed an azimuthal asymmetry in inclusive hadron production by e^+e^- annihilation at the center-of-mass energy $\sqrt{s} = 7.4$ GeV. The asymmetry is caused by the polarization of the circulating beams in the storage ring and allows separate determination of the transverse and longitudinal structure functions. We find that transverse production dominates for $x > 0.2$ where x is the scaling variable $2p/\sqrt{s}$. (AIP)

9625 Observation of an intermediate state in psi (3684) radiative cascade decay. Tanenbaum, W.; Whitaker, J.S.; Abrams, G.S.; Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Chinowsky, W.; Feldman, G.J.; Friedberg, C.E.; Fryberger, D.; Goldhaber, G.; Hanson, G.; Hartill, D.L.; Jean-Marie, B.; Kadyk, J.A.; Larsen, R.R.; Litke, A.M.; Luke, D.; Lulu, B.A.; Luth, V.; Lynch, H.L.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Pierre, F.M.; Pun, T.P.; Rapidis, P.; Richter, B.; Sadoulet, B.; Schwitters, R.F.; Trilling, G.H.; Vannucci, F.; Winkelmann, F.C.; Wiss, J.E. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **35**: No. 20, 1323-1325(17 Nov 1975).

We present evidence for the existence of an intermediate state observed in the decay sequence psi(3684) yields psi(3095)γγ. The mass of the state is either 3500+-10 or 3270+-10 MeV. The branching fraction of the sequence is (3.6+-0.7)%. (AIP)

9626 Evidence for anomalous lepton production in e^+e^- annihilation. Perl, M.L.; Abrams, G.S.; Boyarski, A.M.; Breidenbach, M.; Briggs, D.D.; Bulos, F.; Chinowsky, W.; Dakin, J.T.; Feldman, G.J.; Friedberg, C.E.; Fryberger, D.; Goldhaber, G.; Hanson, G.; Heile, F.B.; Jean-Marie, B.; Kadyk, J.A.; Larsen, R.R.; Litke, A.M.; Luke, D.; Lulu, B.A.; Luth, V.; Lyon, D.; Morehouse, C.C.; Paterson, J.M.; Pierre, F.M.; Pun, T.P.; Rapidis, P.A.; Richter, B.; Sadoulet, B.; Schwitters, R.F.; Tanenbaum, W.; Trilling, G.H.; Vannucci, F.; Whitaker, J.S.; Winkelmann, F.C.; Wiss, J.E. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **35**: No. 22, 1489-1492(1 Dec 1975).

We have found events of the form e^++e^-yieldse/sup plus-or-minus/+μ/sup minus-or-plus/+ missing energy, in which no other charged particles or photons are detected. Most of these events are detected at or above a center-of-mass energy of 4 GeV. The missing-energy and missing-momentum spectra require that at least two additional particles be produced in each event. We have no conventional explanation for these events. (AIP)

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 9150, 9622

9627 Leptonic decays of the Σ^- and Ξ^- hyperons. Tanenbaum, W.; Hungerbuhler, V.; Majka, R.; Marx, J.N.; Nemethy, P.; Sandweiss, J.; Willis, W.J.; Atac, M.; Ecklund, S.; Gollon, P.J.; Lach, J.; MacLachlan, J.; Roberts, A.; Stefanski, R.; Theriot, D.; Wang, C.L. (Yale University, New Haven, Connecticut 06520). *Phys. Rev., D;* **12**: No. 7, 1871-1883(1 Oct 1975).

The decays Σ^-yieldsne$^-$anti ν, Σ^-yieldsΛe$^-$anti ν (Λyieldsπ^-p), and Ξ^-yieldsΛe$^-$anti ν (Λyieldsπ^-p) were studied using unpolarized hyperons from the Yale—Fermilab—BNL hyperon beam at the Brookhaven National Laboratory Alernating Gradient Synchrotron. The Σ^-, Ξ^-, e^-, and Λ-decay-product momenta were measured by magnetic spectrometers with magnetostrictive wire spark chambers. A threshold Cherenkov counter and a total absorption calorimeter identified the electron and neutron, respectively. From a sample of 3507 reconstructed Σ^-yieldsne$^-$anti ν events we have found the abs. value of g/sub A//g/sub V/ = 0.435+-0.035. From a sample of 55 reconstructed Σ^-yieldsΛe$^-$anti ν events we have found g/sub V//g/sub A/ = 0.17+-0.35, assuming that the conserved vector current hypothesis correctly predicts the weak magnetic form factor. A new one-angle Cabibbo fit gives f = 0.436+-0.010, d = 0.812+-0.011, and theta + 0.232+-0.003 radian. (AIP)

9628 Further observation of dimuon production by neutrinos. Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Orr, R.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L.; Wanderer, P. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev. Lett.;* **35**: No. 18, 1199-1202(3 Nov 1975).

By using a quadrupole focused neutrino beam, 61 events with two muons in the final state have been observed at Fermilab. These include seven $\mu^-\mu^-$ events. A comparison of the event rate in two targets of different hadron absorption length indicates that attributing the events to π or K leptonic decay is ruled out by 4.0 standard deviations. No trimuon events were observed; this circumstance, combined with lepton conservation, indicates an unobserved neutral lepton is present in most of the events. (AIP)

9629 Characteristics of dimuons as evidence for a new quantum number. Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Orr, R.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L.; Wanderer, P. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev. Lett.*; **35**: No. 18, 1203-1206(3 Nov 1975).

Neutrino-induced dimuon events probably involve the production and subsequent decay of one or more real, intermediate particles. The observed properties of dimuon events are shown not to agree with the hypotheses that the intermediate particles are heavy leptons or semiweak vector bosons. This result strongly suggests production of new hadrons as the leading explanation of dimuon events. Such new hadrons, decaying weakly, would necessarily possess a new, as yet unidentified, quantum number. (AIP)

9630 Dimuons produced by antineutrinos. Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Orr, R.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L.; Wanderer, P. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev. Lett.*; **35**: No. 19, 1249-1252(10 Nov 1975).

In a run with a predominantly phi-bar beam we have observed seven dimuon events which show clearly that dimuons are produced by phi-bar as well as by phi. Using the signature of those events we tentatively identify twelve dimuon events from earlier runs as phi-bar-induced. The characteristics of the total sample support the explanation that dimuons arise from new hadron production. (AIP)

9631 Measurement of neutrino and antineutrino total cross sections at high energy. Barish, B.C.; Bartlett, J.F.; Buchholz, D.; Humphrey, T.; Merritt, F.S.; Sciulli, F.J.; Stutte, L.; Shields, D.; Suter, H.; Fisk, E.; Krafczyk, G. (California Institute of Technology, Pasadena, California 91125). *Phys. Rev. Lett.*; **35**: No. 20, 1316-1319(17 Nov 1975).

Charged-current ν and anti ν data are reported from the first application at Fermilab of a narrow-band neutrino beam for the measurement of normalized cross sections. Cross sections of about 20% accuracy were measured with a 120-GeV secondary hadron beam for ν (anti ν) originating from π decay (<E/sub ν/>=38 GeV) and K decay (<E/sub ν/>=105 GeV). The ν and anti ν fluxes were determined by directly measuring the hadron flux and the π/K/p ratios for the hadron beam. (AIP)

9632 Inclusive hadron production in inelastic muon-proton scattering at 150 GeV/c. Loomis, W.A.; Matis, H.S.; Anderson, H.L.; Bharadwaj, V.K.; Booth, N.E.; Fine, R.M.; Francis, W.R.; Gordon, B.A.; Heisterberg, R.H.; Hicks, R.G.; Kirk, T.B.W.; Kirkbride, G.I.; Mo, L.W.; Myrianthopoulos, L.C.; Pipkin, F.M.; Pordes, S.H.; Quirk, T.W.; Shambroom, W.D.; Skuja, A.; Verhey, L.J.; Williams, W.S.C.; Wilson, R.; Wright, S.C. (Enrico Fermi Institute, Chicago, Illinois 60637). *Phys. Rev. Lett.*; **35**: No. 22, 1483-1486(1 Dec 1975).

Inclusive hadron production in muon-proton inelastic scattering has been measured for $q^2>0.5$ (GeV/c)^2 and $10<\nu<135$ GeV. The results are presented in the form of the transverse momentum distribution of charged hadrons and the hadron invariant structure function F (x′). Results are given for different regions of q^2 and s. (AIP)

9633 Search for long-lived penetrating neutral particles. Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Jensen, R.B.; Ling, T.Y.; McIntyre, P.; Mann, A.K.; Orr, R.; Reeder, D.D.; Rich, J.; Rubbia, C.; Stefanski, R.; Sulak, L.; Wanderer, P. (Department of Physics, Harvard University, Cambridge, Massachusetts 02130). *Phys. Rev. Lett.*; **35**: No. 22, 1486-1489(1 Dec 1975).

We report on a search for decays of long-lived penetrating neutral particles in the neutrino beam at Fermilab. We find an event rate consistent with background which corresponds to a fraction (7plus-or-minus5) times10^{-3} of ν/sub mu/(nu-bar/sub mu/) scattering in liquid scintillator. This result poses an apparent contradiction to the observations of Krishnaswamy et al. in the Kolar Gold Mines. (AIP)

9634 Production of prompt muons in the forward direction by 400-GeV proton interactions. Leipuner, L.B.; Larsen, R.C.; Adair, R.K.; Bergey, P.D.; Carter, A.B.; Grannan, D.M.; Kasha, H.; Kellogg, R.G.; Lauterbach, M.J. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev. Lett.*; **35**: No. 24, 1613-1616(15 Dec 1975).

The ratio of prompt negative muons to negative pions produced in the forward direction by the interaction of 400-GeV protons on copper has been determined to be 5.8times10^{-5} for 55-GeV muons, 3.05times10^{-5} for 102-GeV muons, and 1.93times10^{-5} for 230-GeV muons. The ratio of prompt positive muons to negative muons was about 1. (AIP)

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 9630, 9634, 9640, 9741, 9864

9635 Observation of structure in elastic pp scattering at 100 and 200 GeV/c. Akerlof, C.W.; Kotthaus, R.; Loveless, R.L.; Meyer, D.I. (Michigan Univ., Ann Arbor (USA). Dept. of Physics); Ambats, I.; Meyer, W.T.; Ward, C.E.W. (Argonne National Lab., Ill. (USA)); Earlty, D.P.; Lundy, R.A.; Pruss, S.M. *Phys. Lett., B;* **59**: No. 2, 197-200(27 Oct 1975).

The elastic differential cross section for pp scattering has been measured up to a momentum transfer of abs. value t = 3 (GeV/c)^2 at 100 GeV/c and 200 GeV/c incident momenta. The 200 GeV/c measurements show a diffractive-like dip at abs. value t = 1.5 GeV/c, while no such dip is seen in the 100 GeV/c data. (NL)

9636 Measurement of elastic scattering of hadrons on protons from 50 to 175 GeV/c. Fermilab Single Arm Spectrometer Group. (I 1380Dh). *Phys. Rev. Lett.*; **35**: No. 18, 1195-1199(3 Nov 1975).

Differential cross sections have been measured at Fermilab with a focusing spectrometer for π^+⁻p, K^+⁻p, and p^+⁻p elastic scattering at 50-, 70-, 100-, 140-, and 175-GeV/c incident momentum over the abs. value of t range 0.03 to 0.8 GeV^2. The results are smooth in t and are parametrized by quadratic exponential fits. (AIP)

9637 Measurement of the pp charge-exchange cross section below 1 GeV/c. Alston-Garnjost, M.; Kenney, R.; Pollard, D.; Ross, R.; Tripp, R.; Nicholson, H. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.*; **35**: No. 25, 1685-1688(22 Dec 1975).

No definite evidence for structure is found in the ppyieldsnn cross section between 276 and 963 MeV/c. From these results limits are deduced on properties of the narrow enhancement reported in the pp total cross section at 475 MeV/c. (AIP)

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 9630, 9636, 9637, 9864

9638 Search for Ξ* resonances in 2.87-GeV/c K⁻n interactions. Briefel, E.; Gourevitch, S.A.; Kirsch, L.; Schmidt, P.; Chang, C.Y.; Staab, R.; Yodh, G.B.; Fernow, R.; Gauthier, P.; Moneti, G.; Goldberg, M.; Canter, J.; Mann, W.A.; Schneps, J.; Tompkins, J.; Wolsky, G. (Brandeis University, Waltham, Massachusetts 02154). *Phys. Rev., D;* **12**: No. 7, 1859-1870(1 Oct 1975).

We report on a search for Ξ* production in the mass range 1.5—2.0 GeV/c^2 in K^-n interactions at 2.87 GeV/c. Upper limits on Ξ* production cross sections, as well as reaction cross sections for those final states in which Ξ*'s may be observed, are presented. In particular, an upper limit of 5.4 μb is placed on production of an isospin-3/2 Ξ^{*--}. (AIP)

9639 Study of diffractively produced five-pion final states. Harris, R.; Lubatti, H.J.; Moriyasu, K.; Podolsky, W.J. (Washington Univ., Seattle (USA). Dept. of Physics); Bingham, H.H.; Fretter, W.B.; Graves, W.R.; Porter, F.C.; Yost, G.P. (California Univ., Berkeley (USA). Dept. of Physics). *Phys. Lett., B;* **59**: No. 2, 187-190(27 Oct 1975).

Diffractively produced five-pion final states are studied in the reaction π^-d yields $3\pi^-2\pi^+$d at 15 GeV/c and compared with predictions of the statistical dissociation model and multiperipheral models. (NL)

9640 Elastic scattering of hadrons at 50 to 200 GeV. Akerlof, C.W.; Kotthaus, R.; Loveless, R.L.; Meyer, D.I.; Ambats, I.; Meyer, W.T.; Ward, C.E.W.; Eartly, D.P.; Lundy, R.A.; Pruss, S.M.; Yovanovitch, D.D.; Rust, D.R. (Physics Department, University of Michigan, Ann Arbor, Michigan 48104). *Phys. Rev. Lett.*; **35**: No. 21, 1406-1408(24 Nov 1975).

The differential cross section for π/sup plus-or-minus/, K/sup plus-or-minus/, and p/sup plus-or-minus/ on hydrogen have been measured in the range $0.07<-t<1.6$ (GeV/c)^2. The dependence on momentum, momentum, transfer, and particle type are discussed. (AIP)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

REFER ALSO TO CITATION(S) 9699, 9707

9641 Unified approach to multiparticle production at high energy. Carruthers, P. (Los Alamos Scientific Lab., NM); Zachariasen, F. pp 349-370 of In Theories and experiments in high-energy physics. Kursunoglu, B. (ed.). New York; Plenum Publishing Corp. ([nd]).

Some pertinent definitions in the nonrelativistic case are reviewed, and it is shown how one may treat the scattering of single particle from a potential well using the transport equation method. The problem of particle production in relativistic field theory is illustrated for scalar field theories involving a c-number potential and for a PHI⁴ self-interaction. The qualitative ideas of this new method are summarized. The formulation of covariant transport theory is treated. (JFP)

9642 Ambiguity in Pade-approximant calculations. Betlach, T.L. (Univ., of California, San Diego, La Jolla). *Lett. Nuovo Cim.;* **13**: No. 18, (23 Aug 1975).

Attention is called to the fact that owing to poor convergence properties, the numerical results of Pade calculations can and do depend sensitively on the way in which one does the renormalization. There is consequently, an element of ambiguity in such calculations. Furthermore, the resulting numerical effects can be quite large. The linear sigma model is used as an illustration. One can calculate the rho width, which characterized the behavior of the amplitude, for which two alternative predictions are made, in the vicinity of the rho mass. The result is MMA ub rho/ approximately equal to 35 MeV. The calculation of this quantity is clearly very sensitive to a change in the renormalization procedure, the reason being the poor convergence properties of the perturbation series. A change in the renormalization procedure is equivalent to a rearrangement of the perturbation series. Finally if the Pade formula is to be used as a basis for phenomenology, these considerations show that one renormalization may yield better fits than another one. (JFP)

9643 Separable solutions for directly interacting particle systems. Foldy, L.L.; Krajcik, R.A. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106). *Phys. Rev., D;* **12**: No. 6, 1700-1710(15 Sep 1975).

The problem of constructing a representation of the Poincare group corresponding to a directly interacting system of a finite number of particles and satisfying the condition that the interaction be separable is considered by expansion of the group generators in powers of $1/c^2$. It is established that the problem has a solution to order $1/c^2$, but, except in special cases, the solution requires that the interaction contain three-body terms to order $1/c^2$ if it is the sum of two-body terms only to nonrelativistic order. Furthermore, there is considerable arbitrariness in the $1/c^2$-order interaction term, and we discuss the possiblity and significance of removing this arbitrariness by a unitary transformation. Finally, we discuss higher-order terms in $1/c^2$, where we present arguments to show that an N-particle system will eventually have some N-body interaction terms at some order in $1/c^2$ even though it contains only two-body terms nonrelativistically, and we then present some applications. (AIP)

9644 Triple-Regge region at subasymptotic energies in Reggeon field theory. Frazer, W.R.; Moshe, M. (Department of Physics, University of California, San Diego, La Jolla, California 92037). *Phys. Rev., D;* **12**: No. 8, 2385-2389(15 Oct 1975).

We derive asymptotic results for the inclusive cross section in the triple-Regge region. The approach to this limit which will be detected at subasymptotic energies is especially emphasized. We discuss also the relation of the asymptotic inclusive cross section to the low-energy perturbation scheme. (AIP)

9645 Regge cuts in inclusive reactions. Paige, F.E.; Trueman, T.L. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **12**: No. 8, 2422-2442(15 Oct 1975).

The contribution of Regge cuts to single-particle inclusive processes is analyzed using the techniques of Gribov. The dependence of these contributions on the polarization state of the target is emphasized. A general formula is obtained and certain contributions to it are calculated. It is not possible, however, to reduce this to a simple, powerful formula expressing the total cut contribution in terms of other measurable quantities, as can be done for the cut contribution to the total cross section. The reasons for this are discussed in detail. The single-particle intermediate states, analogous to the absorption model for elastic scattering, are explicitly calculated as an illustration. (AIP)

9646 Comment on vacuum polarization and the absence of free quarks in four dimensions. Gasiorowicz, S. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev., D;* **12**: No. 8, 2526-2527(15 Oct 1975).

An Abelian model of electric flux line confinement due to Kogut and Susskind is examined, and certain novel features are pointed out. The nonlinear differential equations are studied by means of the phase-plane method, which shows that the size of the confining tube cannot be determined by the linear approximation. (AIP)

9647 Comment on the observation of a moving magnetic monopole. Hungerford, E.V. (Physics Department, University of Houston, Houston, Texas 77004). *Phys. Rev. Lett.;* **35**: No. 19, 1303-1305(10 Nov 1975).

It is determined that if the recent observation of a cosmic-ray track is accepted as produced by a magnetic monopole then the magnetic charge must correspond to a south-seeking pole for a monopole mass less than 6.6×10^3 GeV/c^2. In addition, the pole could not have been produced by a primary cosmic ray in the upper atmosphere. (AIP)

9648 p states of charmonium and the forces that confine quarks. Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). *Phys. Rev. Lett.;* **35**: No. 22, 1540-1543(1 Dec 1975).

A measurement of the energy differences of the n=2, ^{3}P/subj/ states of charmonium may give significant information on the dynamics of the spin-dependent quark-antiquark (qq) forces, since the more rapidly these forces increase with qq separation, the larger the ratios $R_1=[E(^3P_2)-E(^3P_1)]/[E(^3P_1)-E(^3P_0)]$ and $R_2 = [E(^3P_1-E(\ P\ )]/[E(\ P\ )-E(\ P\ )]$ become if the forces are of vector character. (AIP)

9649 Eight-quark model of weak interactions with left-handed currents. Suzuki, M. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **35**: No. 23, 1553-1556(8 Dec 1975).

A gauge model is proposed which contains only left-handed currents of quarks and leptons. The nuclear β-decay current couples to the intermediate boson with partial strength of the gauge coupling, and a new mixing angle is introduced to ensure the universality of the β decay and the μ decay. (AIP)

9650 New gauge model of light and heavy quarks. Clavelli, L.; Raychaudhuri, A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Rev. Lett.;* **35**: No. 24, 1607-1609(15 Dec 1975).

A new anomaly-free gauge model based on an SU(2) direct-productSU(2) direct-productU(1) group is proposed with 32 quarks and leptons. The model permits a dominantly I=0 neutral current, predicts R≅62/3, explains the ΔI=1/2 rule, and allows the charmed quark to decay predominantly to nonstrange particles. (AIP)

9651 Evidence for jet structure in hadron production by e^+e^- annihilation. Hanson, G.; Abrams, G.S.; Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Chinowsky, W.; Feldman, G.J.; Friedberg, C.E.; Fryberger, D.; Goldhaber, G.; Hartill, D.L.; Jean-Marie, B.; Kadyk, J.A.; Larsen, R.R.; Litke, A.M.; Luke, D.; Lulu, B.A.; Luth, V.; Lynch, H.L.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Pierre, F.M.; Pun, T.P.; Rapidis, P.A.; Richter, B.; Sadoulet, B.; Schwitters, R.F.; Tanenbaum, W.; Trilling, G.H.; Vannucci, F.; Whitaker, J.S.; Winkelmann, F.C.; Wiss, J.E. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **35**: No. 24, 1609-1612(15 Dec 1975).

We have found evidence for jet structure in e^+e^-yield shadrons at center-of-mass energies of 6.2 and 7.4 GeV. At 7.4 GeV the jet-axis angular distribution integrated over azimuthal angle was determined to be proportional to $1+(0.78 \pm 0.12)\cos^2\theta$. (AIP)

9652 Relativistic calculation of radiative M1 transitions in charmonium. Feinberg, G.; Sucher, J. (Department of Physics, Columbia University, New York, New York 10027). *Phys. Rev. Lett.;* **35**: No. 25, 1740-1743(22 Dec 1975).

The transition rate for various M1 decay between charmonium S states are calculated elativistically. The rates depend considerably On the quark mas and on the Dirac covariants in the potential. The M1 decays may therefore be a senitive probe of quark interactions. Some numerical results are presented for a linear potential. (AIP)

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 9620, 9650, 9667, 9673, 9677

9653 Gyromagnetic rations and nature of back bending of the moment of inertia. Grin', Y.T. (I. V. Kurchatov Institute of Atomic Energy). *JETP Lett. (USSR) (Engl. Transl.);* **22**: No. 2, 49-50(20 Jul 1975).

It is shown that the gyromagnetic ratio for the rotational excitations take on values that differ significantly from Z/A in the case when the nature of the back bending of the moment of inertia is connected with intersection with the state of broken pair of nucleons at a level with angular momentum j=l+1/2. The dependence of g on the nuclear spin is calculated. (AIP)

9654 Charge form factor of the deuteron and optimized polynomials. Hockert, J.; Jackson, A.D. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). *Phys. Lett., B;* **58**: No. 4, 387-389(29 Sep 1975).

Using pseudodata based on the Reid soft-core potential, the authors consider the extent to which a single measurement of the tensor polarization of recoil deuterons can facilitate the separation of deuteron charge and quadrupole form factors in the range 0 less than q^2 less than 35 fm^{-2}. (NL)

9655 Properties of psiN scattering. Barger, V. (Wisconsin Univ., Madison (USA). Dept. of Physics); Phillips, R.J.N. (Science Research Council, Chilton (UK). Rutherford Lab.). *Phys. Lett., B;* **58**: No. 4, 433-436(29 Sep 1975).

Extracting psi N scattering from photoproduction requires vector meson dominance and diffractive assumptions. It is observed that (i) kinematic corrections to standard vector dominance formulas are important; (ii) both threshold and high-energy behaviors of sigma/sub t/(psi N) support the diffractive assumption; (iii) q^2 dependence in the γ psi coupling could imply larger psi N cross sections; (iv) in any case sigma/sub t/ is bounded through the slope of d sigma/dt and sigma/sub el//sigma/sub t/ remains small. (NL)

9656 Some meson coupling constants in broken SU(4) and the radiative decays of psi and eta/sub c/ . Aubrecht II, G.J.; Razmi, M.S.K. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). *Phys. Rev., D;* **12**: No. 7, 2120-2123(1 Oct 1975).

We calculate vector—pseudoscaler—pseudoscalar and vector—vector—pseudoscalar coupling constants in broken SU(4) by using current algebra and partial conservation of the axial-vector current. As applications of our results, estimates of the decay widths GAMMA(psiyieldsX$^0\gamma$), GAMMA(psiyieldseta/sub c/γ), and GAMMA(eta/sub c/yields2γ) are presented. (AIP)

9657 Estimate of the rate of the rare decay π^0 yields 3γ . Dicus, D.A. (Center for Particle Theory, Department of Physics, The University of Texas, Austin, Texas 78712). *Phys. Rev., D;* **12**: No. 7, 2133-2136(1 Oct 1975).

An estimate is given for the decay rate of the neutral pion into three photons by using a single quark loop in a model with parity violation. (AIP)

9658 γ-ray cascade decays from psi' (3684) to psi (3095). Feldman, G.J.; Gilman, F.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 7, 2161-2163(1 Oct 1975).

The consequences of the existence of the γ-ray cascade decay psi' (3684) yields γ + X and X yields γ + psi (3095) are examined. The kinematics of the resulting 2γ mass spectrum together with the observed dynamics of the neutral missing mass in psi' (3684) yields psi (3095) + neutrals are shown to be of such a form that a stringent upper limit can be placed on the sum of all such transitions. (AIP)

9659 Nonleakage of quark charge moments in sequential fragmentation models. Novoseller, D. (California Institute of Technology, Pasadena, California 91109). *Phys. Rev., D;* **12**: No. 7, 2172-2175(1 Oct 1975).

Simple sequential-fragmentation models for deep-inelastic processes may be tested by comparing powers of the total charge in the quark fragmentation region and adjoining plateau, without reference to the mechanism for producing hadrons from quarks. (AIP)

9660 Mass-operator calculation of the electron g factor. Carroll, R. (The University of Michigan, Ann Arbor, Michigan 48104 and The University of Utah, Salt Lake City, Utah 84112). *Phys. Rev., D;* **12**: No. 8, 2344-2355(15 Oct 1975).

We report on a mass-operator calculation of sixth-order contributions to the electron magnetic moment. We consider contributions with zeroth-order photon Green's functions and use an expansion of the mass operator equivalent to a perturbation series in the bound interaction picture. The method for isolating magnetic moment contributions in the mass operator is described using symmetric integration techniques on integrals with noncommuting momenta. Particular attention is given to the subtraction of both ultraviolet and infrared singularities in the numerical calculation. Our result (2σ uncertainty in parentheses) is a contribution of $0.75(11)(\alpha/\pi)^3$ that gives a total sixth-order contribution of $1.02(11)(\alpha/\pi)^3$. Systematic and random errors are discussed. (AIP)

9661 Hadronic vacuum polarization effects in Bhabha and Moller scattering. Budny, R. (Stanford Univ., Calif. (USA). Inst. of Theoretical Physics). *Phys. Lett., B;* **59**: No. 2, 168-170(27 Oct 1975).

Effects of hadronic vacuum polarization in the reactions e^+e^- yields e^+e^- and e^+e^+ yields e^+e^+ are discussed. The cross sections with spin polarization are given. Measurements of these effects could directly determine in the hadronic vacuum polarization at spacelike momentum transfers and could improve tests of quantum electrodynamics. (NL)

9662 Kinematic constraints on the production of magnetic monopoles. Wilson, L.W. (Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **35**: No. 17, 1126-1128(27 Oct 1975).

A lower limit for the lab energy of a magnetic monopole produced from a stationary target is derived and used to study implications of the data of Price et al. (AIP)

9663 Pion and nucleon structure functions near x = 1. Farrar, G.R.; Jackson, D.R. (California Institute of Technology, Pasadena, California 91125). *Phys. Rev. Lett.;* **35**: No. 21, 1416-1419(24 Nov 1975).

In a colored-quark and vector-gluon model of hadrons we show that a quark carrying nearly all the momentum of a nucleon ($x \approx 1$) must have the same helicity as the nucleon; consequently νW_2 /subn//νW_2 pyields3/7 as xyields1, not 2/3 as might naively have been expected. Furthermore as xyields1, νW_2/sup pi/~ $(1-x)^2$ and (σ/subL//σ/subT/)/sup pi/~$\mu^2Q^{-2}(1-x)^{-2}$+O (g^2); the resulting angular dependence for e^+e^-yieldsh/sup plus-or-minus/+X is consistent with present data and has a distinctive form which can be easily tested when better data are available. (AIP)

9664 How many charm quantum numbers are there. Pais, A.; Treiman, S.B. (Rockefeller University, New York, New York 10021). *Phys. Rev. Lett.;* **35**: No. 23, 1556-1559(8 Dec 1975).

We address the question, how many kinds of new quantum numbers ("charm") are indicated by recent experimental developments in the study of e^+e^- collision phenomena and dimuon production in neutrino and antineutrino reactions (AIP)

9665 Polarization of colliding e^+e^- beams at SPEAR II. Learned, J.G.; Resvanis, L.K.; Spencer, C.M. (University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev. Lett.;* **35**: No. 25, 1688-1690(22 Dec 1975).

We have studied the angular distribution for the reactions e^+e^-yieldse$^+e^-$ and e^+e^-yields$\mu^+\mu^-$ at beam energies of 1.55, 3.1, and 3.7 GeV at SPEAR II. At a beam energy of 3.7 GeV a significant azimuthal asymmetry was observed indicating that the electron and positron beams are strongly polarized. The angular distribution of the μ pairs was found to be in good agreement with the predictions of quantum electrodynamics. The equilibrium value of the polarization and the polarization time constant are found to be P_0=0.76plus-or-minus0.05 and tau =10plus-or-minus$^{+20}_{5}$ min. (AIP)

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 9664, 9742, 9759

9666 (ORO—3992-242) **Lepton scattering and the slope of the Regge trajectory in an SU_2 x SU_2 x U_1 gauge theory.** Dicus, D.A.; Teplitz, V.L.; Young, J.E. (Texas Univ., Austin (USA). Center for Particle Theory). Dec 1975. Contract AT(11-1)-3069. 11p. Dep. NTIS $3.50.

One considers again an SU_2 x SU_2 x U_1 gauge theory in which the left-handed leptons (e, ν/sub e/, μ, ν/sub mu/) are in a quartet representation. The model is motivated by requiring duality in its Regge region. One checks that the energy of the Regge region is high but not absurd so that the slopes of the trajectories are not so small as to make the Regge recurrence region forever inaccessible. One also revises the prediction for sub e/e elastic scattering. (auth)

9667 Nonleptonic decays of charmed mesons: Implications for e^+e^- annihilation. Einhorn, M.B.; Quigg, C. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **12**: No. 7, 2015-2030(1 Oct 1975).

Using a generalization of the abs. value of $\Delta I = 1/2$ rule, we analyze the nonleptonic weak decays of pseudoscalar charmed mesons. We call attention to the likelihood that the dominant decays will be into many-body channels. Special attention is devoted to the properties of charmed final states just above charm threshold in e^+e^- annihilation. The questions of charged multiplici-

ty, copious kaon production, and energy carried by neutrals are explored. (AIP)

9668 Lepton g-2 in a dual gauge model. Dicus, D.A. (Center for Particle Theory, Department of Physics, The University of Texas, Austin, Texas 78712). *Phys. Rev., D;* **12**: No. 7, 2176-2177(1 Oct 1975).

The weak correction to the lepton's magnetic moment is calculated in a gauge model which exhibits a form of duality. (AIP)

9669 Neutrino magnetic moment, plasmon Cerenkov radiation, and the solar-neutrino problem. Radomski, M. (California Institute of Technology, Pasadena, California 91125). *Phys. Rev., D;* **12**: No. 8, 2208-2211(15 Oct 1975).

Clark and Pedigo suggested that, if the neutrino has a magnetic moment, the energy loss of a solar neutrino in escaping the sun, due to magnetic elastic scattering off electrons, could help explain the absence of detection of solar neutrinos at earth. Collective effects of the solar plasma will modify the energy loss calculated by those authors. The existence of the possibility of Cerenkov radiation of longitudinal plasmons suggests that the effect might be large and positive. Detailed calculation shows that it is actually a small effect on the energy loss and not of likely impact on the solar-neutrino problem. (AIP)

9670 Neutral heavy leptons as a source for dimuon events: A criterion. Pais, A.; Treiman, S.B. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev. Lett.;* **35**: No. 18, 1206-1207(3 Nov 1975).

Suppose that a neutral, heavy, spin-1/2 lepton were created by a mixed neutrino—antineutrino beam incident on an arbitrary target and that this lepton subsequently decayed into a μ pair and a neutrino (or antineutrino). Then the ratio of the respective mean laboratory energies for the μ^- and μ^+ lies between 0.48 and 2.10. (AIP)

9671 Comment on direct lepton production. Lederman, L.M.; White, S. (Columbia University, New York, New York 10027). *Phys. Rev. Lett.;* **35**: No. 22, 1543-1546(1 Dec 1975).

Recent data on observations of direct leptons produced in proton-proton collisions are analyzed. It is found that the large bulk of the data can be accounted for if the origin of the leptons is a low-mass, ~ (1 to 5) m/sub pi/, vector meson which decays weakly into $\mu+\nu$ and $e+\nu$ symmetrically. The proposed object is produced and decays with a cross section times branching ratio of 10^{-3} of the pion production cross section. (AIP)

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 9661, 9693, 9698

9672 (SLAC—188) Quarks and bubbles: the dynamics of a field theory model of hadron structure. Giles, R.C. III. (Stanford Linear Accelerator Center, Calif. (USA)). Nov 1975. Contract E(04-3)-515. 103p. Dep. NTIS $5.50.

The semi-classical dynamics of the field theory model of hadron structure proposed by Bardeen, Chanowitz, Drell, Weinstein, and Yan (BCDWY) is analyzed. The BCDWY model is based on a field theory of quarks interacting via the Yukawa coupling with a quartically self-coupled scalar field which acquires a nonzero vacuum expectation value. BCDWY have shown that in a strong coupling limit, though the quark acquires a large dynamically generated bare mass, low mass particle-like bound states containing quarks ("bubbles") can form. (JFP)

9673 Quarks with charm and color: a new model of their strong and weak interactions. Ma, E. (California Univ., Santa Barbara (USA). Dept. of Physics). *Phys. Lett., B;* **58**: No. 4, 442-444(29 Sep 1975).

The motivation and the consequences of taking the charmed quark to be a 6* under color SU(3) are discussed. Among the many features of this new quark scheme is that charmed mesons are heavier than charmed baryons. (NL)

9674 Masses and other parameters of the light hadrons. DeGrand, T.; Jaffe, R.L.; Johnson, K.; Kiskis, J. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 7, 2060-2076(1 Oct 1975).

The masses and static parameters of the light hadrons (the pseudoscalar and vector meson nonets and the baryon octet and decuplet) are calculated using the bag model. The effects of quark kinetic energy, bag energy, strange-quark mass, colored-gluon exchange in lowest order, and energy associated with certain quantum fluctuations are included. These are parameterized by four constants which have fundamental significance and do not change from multiplet to multiplet. The fit to the spectrum is good. The ordering of all the states is given correctly. The intramultiplet splittings are very accurate for the baryon decuplet and reasonably good for the other multiplets. The isosinglet pseudoscalar mesons eta and eta' are treated separately in light of the special role that gluon intermediate states play in these states. Magnetic moments, weak decay constants, and charge radii are calculated. Where comparison with experiment is possible, we generally obtain improvement over the naive quark model. It is shown that exotic baryons do not exist as narrow resonances in this approximation to the bag theory. (AIP)

9675 Elastic scattering slope and total cross section relations. Barger, V. (Wisconsin Univ., Madison (USA). Dept. of Physics); Phillips, R.J.N. (Science Research Council, Chilton (UK). Rutherford Lab.). *Nucl. Phys., B;* **97**: No. 3, 452-460(20 Oct 1975).

The empirical equality of B²/sigma/sub t/ is noted for the pomeron terms in NN, πN, KN, rhoN, ωN, and phiN scattering, where B is the elastic slope parameter and sigma/sub t/ is the total cross section. This ratio increases slowly with energy, but remains the same in all channels. This is equivalent to a relation between the diffractive interaction radii and opacities; the opacity scales with the square of the radius. It is conjectured that this systematics extends to psiN scattering. B²/sigma/sub t/ universality is contrasted with the slope predictions of an f-coupled pomeron model. Some other predictions of the f-dominance hypothesis are tested against data. (NL)

9676 Alternative quark model with charm. Goto, T.; Mathur, V.S. (Rochester Univ., N.Y. (USA). Dept. of Physics and Astronomy). *Phys. Lett., B;* **59**: No. 2, 153-156(27 Oct 1975).

A quark model is presented for SU(4) group, where the charged quark carries a charge $Q = -4/3$. Various experimental consequences of this model are discussed and comparison with the model of Glashow et al. is made, especially with regard to the experimental features of the psi(3105) resonance. (NL)

9677 Possible degeneracy of heavy quarks. Wilczek, F. (Princeton Univ., N.J. (USA). Joseph Henry Labs.). *Phys. Lett., B;* **59**: No. 2, 179-181(27 Oct 1975).

In an attempt to understand the behavior of the total cross-section in the electron—positron annihilation, it is suggested that two types of heavy quarks might exist with masses split only by the weak interactions. Implications and tests of this suggestion are discussed. (NL)

9678 Quantum-number exchanges at extremely high energies. McCoy, B.M.; Tsun Wu, T. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Phys. Rev. Lett.;* **35**: No. 18, 1190-1192(3 Nov 1975).

We study systematically the high-energy behavior of backward Compton scattering and pair annihilation in massive quantum electrodynamics. For both of these processes (where a fermion is exchanged), we find, in the complex angular-momentum plane, a fixed cut with a simple pole coming out at a physical value of momentum transfer. These results are used to discuss possible behaviors, at extremely high energies, of hadronic processes with the exchange of quantum numbers. (AIP)

9679 Photoproduction of the psi (3100) meson at 11 GeV. Gittelman, B.; Hanson, K.M.; Larson, D.; Loh, E.; Silverman, A.; Theodosiou, G. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). *Phys. Rev. Lett.;* **35**: No. 24, 1616-1619(15 Dec 1975).

The photoproduction of the psi (3100) meson from a beryllium target has been measured using an 11.8-GeV bremsstrahlung beam. The energy and angular dependence of the measured spectra may be obtained from an elastic nucleon cross section of the form dσ/dt= (1.01plus-or-minus0.20) exp(1.25plus-or-minus0.20) t nb/GeV². This cross section is exceedingly small in comparison with those of the other vector mesons. (AIP)

STRONG INTERACTIONS, BARYON NO. 0

REFER ALSO TO CITATION(S) 9642, 9671, 9689

9680 Corrections to the Gell-Mann—Okubo formula due to second-order SU(4) breaking. Simard, R.; Suzuki, M. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev., D;* **12**: No. 7, 2002-2006(1 Oct 1975).

It is shown by a current-algebra technique that second-order SU(4)-breaking effects shift the charmed-vector-meson masses upwards from the values predicted by the quadratic Gell-Mann—Okubo formula. The magnitude of the shift is estimated in a simple quark model of meson coupling constants. (AIP)

9681 Meson mass formula from duality. Frampton, P.H. (Department of Physics, Syracuse University, Syracuse, New York 13210). *Phys. Rev., D;* **12**: No. 7, 2164-2165(1 Oct 1975).

A general mass formula for meson levels in the symmetric-group dual resonance model is written in terms of the corresponding quark-model quantum numbers. (AIP)

9682 Nonspherical deformations of hadronic bags. Rebbi, C. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 8, 2407-2421(15 Oct 1975).

A Hamiltonian formalism is developed to describe the classical motion of a bag-type model for small oscillations of the boundary around a static configuration and to give an approximate quantization of the system. It is shown that in the case of the one-dimensional bag the method reproduces the exact form of the mass-squared operator, which is known from the light-cone quantization. The formalism is then applied to the study of a three-dimensional bosonic bag and in particular to the analysis of the P-wave excitations. (AIP)

9683 Linear Regge trajectories for the psion family and O(4) dynamics. Chang, N.; Nelson, C.A. (Physics Department, City College of the City University of New York, New York, New York 10031). *Phys. Rev. Lett.;* **35**: No. 22, 1492-1495(1 Dec 1975).

The newly discovered psion family can be described by mass-squared linear Regge trajectories. The new J/subP//subC/ assignments are for 2.8 GeV/c^2, 0^{++}, and for the 3.4 region, 2^{++}, 1^{-+}, 0^{++}. All radiative decays are related through a single S/sub mu//sub nu/F/sub mu//sub nu/ coupling. A good fit is obtained. (AIP)

9684 Fine-structure corrections and electromagnetic decays of charmonium. Pumplin, J.; Repko, W.; Sato, A. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev. Lett.;* **35**: No. 22, 1538-1540(1 Dec 1975).

We calculate fine-structure corrections to the spectrum of psi/J particles in the charmonium model, assuming that the linear potential which confines the quarks is due to an effective vector exchange. We also calculate the electromagnetic decay rates between the various low-lying s and p states. (AIP)

STRONG INTERACTIONS, BARYON NO. 1

9685 (LBL—3628) Details of formalism of a + b yields 1 + 2 + 3 including subenergy unitarity. Goradia, Y. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1975. Contract W-7405-ENG-48. 59p. Dep. NTIS $5.50.

A formalism to include subenergy unitarity in a + b yields 1 + 2 + 3 was presented earlier by Goradia and Lasinski. One discussed the details of this formalism and its application to πN yields $\pi\pi N$. (auth)

9686 Unnatural parity exchange in π^+p yields (rho,ω)Δ^{++}. Owens, J.F.; Eisner, R.L. (Case Western Reserve Univ., Cleveland, Ohio (USA)); Chung, S.U.; Protopopescu, S.D. (Brookhaven National Lab., Upton, N.Y. (USA)). *Phys. Lett., B;* **58**: No. 3, 376-380(15 Sep 1975).

The magnitudes and relative phases of the unnatural parity exchange amplitudes in π^+p yields (rho^0, ω)Δ^{++} are determined at 7.1 GeV/c using a model dependent amplitude analysis technique. (NL)

9687 Strong production mechanisms and total cross sections of psi particles. Gaisser, T.K.; Halzen, F.; Kajantie, K. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081). *Phys. Rev., D;* **12**: No. 7, 1968-1974(1 Oct 1975).

New BNL and Fermilab data on the production of psi particles in hadron collisions are shown to imply that the intrinsic production cross section of a particle of mass m varies as $1/m^2$ and scales in the variable ($s^{1/2}$ - s/sub threshold/$^{1/2}$)/m. Vector-meson—proton total cross sections are also observed to be proportional to $1/m^2$, and a connection between production mechanisms and total cross sections is pointed out. On the basis of the existence of high-mass diffraction dissociation in hadron collisions, explicit estimates for diffractive production of psi are also given. Our calculations are also directly applicable to the hypothetical charmed particles. (AIP)

9688 πp elastic scattering and peripherel reactions. Yokosawa, A. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **35**: No. 25, 1738-1739(22 Dec 1975).

We show that gp charge exhchange and πp backward elastic scattering at intermediate energies are peripheral reactions. The backward scattering at high energies, say 6 GeV/c, has not been successfully interpreted in terms of baryon-exchange processes. We present a new way to study the backward scattering. (AIP)

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 9671

9689 Deck model applied to baryonic systems. Cutler, R.T.; Wyld, H.W. Jr. (Department of Physics, University of Illinois, Urbana, Illinois 61801). *Phys. Rev., D;* **12**: No. 7, 1952-1967(1 Oct 1975).

Reggeized Deck model calculations are performed for the reactions p anti p yields p anti p $\pi^+\pi^-$, pp yields pp$\pi^+\pi^-$, and pp yields pX. The calculations are compared with a new CERN—Serpukhov experiment at 25 and 40 GeV for the first reaction and with recent high-energy data from Fermilab and the CERN ISR for the other two reactions. (AIP)

9690 Hadronic production of the new resonances: Probing gluon distributions. Einhorn, M.B.; Ellis, S.D. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **12**: No. 7, 2007-2014(1 Oct 1975).

Assuming that the new resonances observed at 3095 and 3684 MeV are bound states of a new, heavy quark and its antiquark, we consider several models for the production of such states in hadronic collisions. The dominant mechanism by which these particles couple to other hadrons (composed of normal quarks) may be via gluons. In analogy with the Drell-Yan model for quark-antiquark annihilation into a massive virtual photon, those new particles with even charge conjugation may be regarded as produced by gluon-gluon annihilation. Thus the (presently) hypothetical 0^{-+} partner (eta/sub c/) of the observed particles may serve as a short-distance probe of the gluon distributions within hadrons. We estimate the production cross section of eta/sub c/ in nucleon—nucleon collisions by using various models for gluon distributions. In addition, estimates are made for the production of finite states containing pairs of charmed hadrons in the central region. (AIP)

9691 Implications of high energy pion-nucleon scattering data for pion-nucleus scattering. Ernst, D.J.; Miller, G.A. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). *Phys. Rev., C;* **12**: No. 6, 1962-1967(Dec 1975).

Energy-dependent separable potentials are generated by solving the inverse problem for three sets of pion-nucleon phase shifts which differ only at very high (E/sub c.m./ > 1900 MeV) energies. While the off-shell t matrices thus generated have substantial differences, these effects are small for π-nucleus cross sections as calculated within the impulse approximation. (AIP)

9692 T asymmetry in the strong interaction at medium energies. Bryan, R.A. (Center for Particle Theory, University of Texas at Austin, Austin, Texas 78712 and Research Institute for Theoretical Physics, University of Helsinki, Siltavuorenpenger 20, SF-00170 Helsinki 17, Finland). *Phys. Rev., C;* **12**: No. 6, 1968-1973(Dec 1975).

We examine current intermediate-energy nucleon-nucleon data sensitive to T asymmetry and conclude that of these data, some np polarization and asymmetry measurements give the best evidence that T is good, despite the fact that these data have the largest errors of any of the data considered. This conclusion is reached using a one-boson-exchange potential due to Bryan and Gersten, wherein T is violated at short distances. We argue that any short-range T-asymmetric model would probably lead to the same conculsion. We show that the current N-N data admit the possibility of strong-interaction T asymmetry, so long as it be of short range. For experimentalists who may search for strong-interaction T violation in intermediate energy N-N scattering, we suggest maximum errors for several measurements so that any such T violation may not be missed. (AIP)

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

REFER ALSO TO CITATION(S) 9702

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 9656

9693 Deep-inelastic data as a test of hadron symmetries. Palmer, W.F.; Wada, W.W. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **12**: No. 7, 1975-1977(1 Oct 1975).

It is proposed that the deep-inelastic electron- and neutrino-scattering data near x = 0 provide a way of distinguishing between SU(3) and SU(4) as the fundamental underlying hadron symmetry. (AIP)

9694 Six-quark model for the suppression of ΔS = 1 neutral currents. Guersey, F.; Ramond, P.; Sikivie, P. (Department of Physics, Yale University, New Haven, Connecticut 06520). *Phys. Rev., D;* **12**: No. 7, 2166-2168(1 Oct 1975).

We propose an alternative arising naturally in a six-quark model to the Glashow—Iliopoulos—Maiani mechanism for the suppression of ΔS = 1 neutral currents. While violating the Cabibbo form of universality, it maintains the tan² theta/sub C/ suppression of strange particle decays and introduces an additional tan theta/sub C/ suppression of charmed-particle decays. (AIP)

APPLICATIONS TO STRONG INTERACTIONS

REFER ALSO TO CITATION(S) 9680

FIELD THEORY

REFER ALSO TO CITATION(S) 9678, 9709

9695 Quantum fluctuations in a phi⁴ field theory. II. One-mode approximation. Chang, S.; Wright, J.A. (Physics Department, University of Illinois, Urbana, Illinois 61801 and Fermi National Accelerator Laboratory, Batavia, Illinois 61510). *Phys. Rev., D;* **12**: No. 6, 1595-1605(15 Sep 1975).

We study the effect of quantum fluctuations on one-particle states in a phi⁴ field theory, using a self-consistent Hartree-type approximation. For one-particle states, the presence of quantum fluctuations implies that perturbation theory should not be done about the c-number constant field associated with the vacuum, but rather one should start with a space-dependent classical field specially chosen for the single-particle state. The classical field no longer obeys the classical field equations; it emerges from a self-consistent calculation including the effect of quantum fluctuations. In this paper, we make a further approximation by keeping only the lowest quantum mode in the fluctuation (i.e., the one-mode approximation.) We demonstrate that the inclusion of a single mode in the quantum fluctuations is enough to produce many physically interesting results which are qualitatively different from those obtained in a purely classical system. In particular, we find that a stable "baglike" solution emerges naturally. We determine the particle wave functions, the space-dependent classical fields, and the energies of these baglike one-particle states explicitly in both the weak- and the strong-coupling limits. We exhibit the numerical solutions for intermediate coupling strengths. Finally, we discuss briefly the connections of our solutions and the kink—antikink bound-state solutions obtained by Dashen, Hasslacher, and Neveu. (AIP)

9696 Semiclassical scattering of quantized nonlinear waves. Jackiw, R.; Woo, G. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 6, 1643-1649(15 Sep 1975).

The relation between semiclassical phase shift and time delay, familiar from quantum mechanics, is extended to quantum field theory. This provides a semiclassical description of the scattering of quantized nonlinear waves. After a study of Levinson's theorem, our methods are applied to the sine-Gordon theory and the nature of the forces arising here is discussed. Finally, a covariant perturbative expansion for the one-particle sector is derived. (AIP)

9697 Canonical quantization of nonlinear waves. Tomboulis, E. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 6, 1678-1683(15 Sep 1975).

By means of a canonical transformation we investigate nonlinear field theories that possess exact classical solutions. This transformation is equivalent to the method of collective coordinates recently applied to the same problem by Gervais and Sakita using functional techniques. It is pointed out that, because of the operator orderings, extra terms occur in the quantized theory which seem to be absent in the straightforward functional approach. Ordinary perturbation treatment of the resulting Hamiltonian reproduces results previously obtained by Goldstone and Jackiw using a different technique. (AIP)

9698 Gauge theory at finite temperature of SU(3)-symmetry breaking and quark masses. Eliezer, S. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., D;* **12**: No. 6, 1739-1741(15 Sep 1975).

SU(3) breaking is described in a renormalizable gauge field theory at finite temperature. At high temperature a phase transition occurs and SU(3) becomes an exact symmetry. In a theory with one single parameter $e^2/4\pi = 1/137$, we estimate the masses of P (or N) and λ quarks to be greater than 300 MeV and 7000 MeV, respectively. However, for a small Yukawa coupling or at high temperature these values can be reduced to ~ 10 MeV and ~ 200 MeV, respectively. (AIP)

9699 Dynamical symmetry breaking as a bootstrap. Mannheim, P.D. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., D;* **12**: No. 6, 1772-1793(15 Sep 1975).

This paper is concerned with the bootstrap nature of dynamical symmetry breaking and with the infrared origins of the mass of the electron. We present a general calculational procedure for handling the situation in which a composite operator psi-bar psi acquires a dynamical vacuum expectation value. We apply our procedure to finite quantum electrodynamics to show how the infrared divergences of the theory self-consistently cause <psi-bar psi> to become nonzero nonperturbatively so that it can provide a scale for a purely dynamical electron mass. Since no Goldstone boson need accompany this spontaneous breakdown, the electron mass bootstraps itself about the γ_5 degenerate vacuum. The mechanism also yields a new eigenvalue condition for the fine-structure constant. We discuss the deep interplay between the ultraviolet and the infrared, a characteristic feature of dynamical symmetry breaking. We use this interplay to show how to extend the Wilson operator-product expansion to the situation in which there is a degenerate vacuum. We discuss the possibility that the infrared structure of the weak interaction provides a dynamical origin for the Gell-Mann, Oakes, and Renner Hamiltonian. We indicate briefly the possibility that anomalous dimensions can soften a 4-Fermi interaction sufficiently to make it renormalizable. (AIP)

9700 Infrared behavior of the Reggeon field theory for the Pomeron. Bardeen, W.A.; Dash, J.W.; Pinsky, S.S.; Rabl, V. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 and Institute for Theoretical Physics, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 6, 1820-1828(15 Sep 1975).

The infrared structure of Reggeon field theory is investigated using renormalization-group methods. The infrared fixed point where only the phi³ interaction is nontrivial is shown to be stable with respect to all higher-order interactions within the context of perturbation theory both at D = 2 and in the ε expansion. This may imply that the asymptotic behavior of the total cross section is model independent. (AIP)

9701 Exact localized solutions of two-dimensional field theories of massive fermions with Fermi interactions. Lee, S.Y.; Kuo, T.K.; Gavrielides, A. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Phys. Rev., D;* **12**: No. 8, 2249-2253(15 Oct 1975).

The classical equations of motion for field theories of massive fermions with Fermi interactions in one space and one time dimension are investigated. It is shown that they all possess exact stationary solutions which are localized, due to the vanishing of the stress tensor, a feature for this type of solutions only in two dimensions. The explicit forms of these solutions are presented. More importantly, exact solutions for the bound state of N localized massive fermions with scalar or vector Fermi interactions are also found. (AIP)

9702 Spontaneous symmetry breaking in O(N) -symmetric phi⁶ theory in the 1/N expansion. Townsend, P.K. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). *Phys. Rev., D;* **12**: No. 8, 2269-2285(15 Oct 1975).

An O(N) -symmetric scalar field theory with phi⁴ and phi⁶ coupling is considered to leading order in the 1/N expansion for one, two, and three space-time dimensions. The effective potential is derived and conditions for spontaneous symmetry breaking studied. In one and two dimensions symmetry breaking is impossible. In three dimensions symmetry breaking can occur, and the vacuum expectation values of the fields are given by the tree-approximation result for an appropriate choice of renormalized parameters. There are possible first- and second-order transitions to an O(N) -asymmetric vacuum and a tricritical point. Critical behavior is not discussed in detail in this paper, however. A technique is introduced which allows the derivation of all the Green's functions of the theory to leading order in 1/N. The propagators in the asymmetric vacuum are derived and found to be well behaved and,

in three dimensions, qualitatively similar to λphi⁴ theory. These conclusions are checked by independent methods, verifying to leading order the consistency of the 1/N expansion for this model. (AIP)

9703 Combined supersymmetric and gauge-invariant field theories. de Wit, B.; Freedman, D.Z. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Phys. Rev., D;* **12**: No. 8, 2286-2297(15 Oct 1975).

The combined supersymmetric and gauge-invariant field theories are formulated using ordinary fields, not superfields, from the start, thereby eliminating reference to superfluous components. The construction is a generalization to supersymmetry of the minimal-coupling procedure of ordinary gauge theories. The Lagrangians obtained coincide with those of the superfield approach in the Wess-Zumino gauge. The Ward-Takahashi identities of Green's functions for fields and supersymmetry currents are obtained by functional methods. The Ward-Takahashi identities are presented in a form from which low-energy theorems for Goldstone fermions can be directly derived, and the proof of the Goldstone theorem in these combined theories is clarified. Discussion of the closure of the supersymmetry algebra leads to the concept of gauge-invariant translations for which the conserved current is a gravitational energy-momentum tensor. Some of the results are valid in a broader context than supersymmetry and are applicable to gauge theories in general. (AIP)

9704 Solutions of the Callan-Symanzik equation in a complex neighborhood of zero coupling. Khuri, N.N. (Rockefeller University, New York, New York 10021). *Phys. Rev., D;* **12**: No. 8, 2298-2310(15 Oct 1975).

In this paper we investigate some of the consequences of having the vertex functions in a field theory or a model, that satisfy the Callan-Symanzik equation, also satisfy some analyticity and uniformity properties in the coupling constant g. The solutions of the Callan-Symanzik equation in a complex neighborhood of the origin are studied. The implications of analyticity in g to scaling, anomalous dimensions, and Borel summability for large Euclidean momenta are pointed out. The input we start with, though not yet established in four-dimensional field theories, has been proved for two-dimensional phi⁴ theories. It also happens to be true in many "models" discussed in the literature in connection with Bjorken scaling. (AIP)

9705 Mass independence of critical exponents in perturbation theory. Shapiro, J.A.; Wong, T.F. (Department of Physics, Rutgers, The State University, New Brunswick, New Jersey 08903). *Phys. Rev., D;* **12**: No. 8, 2390-2393(15 Oct 1975).

The suggestion of Dash and Harrington that the critical exponent γ at the fixed point may be found in perturbation theory by its independence of the mass is investigated in the Reggeon calculus and in phi⁴ theory in three dimensions $(phi^4)_3$. We discuss an ambiguity due to the choice of energy scale and find an invariant criterion for determining the point of mass independence. Neither the Reggeon calculus nor $(phi^4)_3$ satisfies this criterion, and no natural choice of energy scale works for $(phi^4)_3$ in second order. (AIP)

9706 Spontaneously broken Abelian-gauge-invariant supersymmetric model. Mainland, G.B.; Tanaka, K. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **12**: No. 8, 2394-2396(15 Oct 1975).

We present a model that is invariant under an Abelian gauge transformation and a modified supersymmetry transformation. This model is broken spontaneously and the interplay between symmetry breaking, Goldstone particles, and mass breaking is studied. In the present model, spontaneously breaking the Abelian symmetry of the vacuum restores the invariance of the vacuum under a modified supersymmetry transformation. (AIP)

9707 Field-theoretic Lagrangian with baglike solutions. Chodos, A. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 8, 2397-2406(15 Oct 1975).

A local Lagrangian involving self-coupled charged scalar fields is studied. The theory exhibits classical confined solutions which coincide with solutions of the analogous MIT bag model, even though no reference is made to a specific region of space in formulating the theory, and no auxiliary fields are used to generate the confining potential. Some of the quantum aspects of the theory are explored by means of a variational calculation, and it is shown that the trial wave functional which is used gives rise to the same form for the energy as is obtained in the cavity approximation to the bag model. (AIP)

SCATTERING THEORY

REFER ALSO TO CITATION(S) 9696, 9705

9708 Microlocal study of S-matrix singularity structure. Kawai, T. (California Univ., Berkeley (USA). Dept. of Mathematics; Kyoto Univ. (Japan). Research Inst. for Mathematical Sciences); Stapp, H.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 38-48 of In International symposium on mathematical problems in theoretical physics. Araki, H. (ed.). Berlin, F.R. Germany; Springer (1975).

From International symposium on mathematical problems in theoretical physics; Kyoto, Japan (23 Jan 1975).

3 figs.; 10 refs.

Support is adduced for two related conjectures of simplicity of the analytic structure of the S-matrix and related function; namely, Sato's conjecture that the S-matrix is a solution of a maximally over-determined system of pseudo-differential equations, and our conjecture that the singularity spectrum of any bubble diagram function has the conormal structure with respect to a canonical decomposition of the solutions of the relevant Landau equations. This latter conjecture eliminates the open sets of allowed singularities that existing procedures permit. (DE)

9709 Is absorption a consequence of unitarity. Sachrajda, C.T.; Blankenbecler, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 6, 1754-1764(15 Sep 1975).

Absorptive corrections to scattering and production in a family of explicitly unitary models are studied. We find that in a particular model in which quantum-number constraints are ignored, all the results concerning absorptive corrections found in the Reggeon calculus model of Abramovskii, Kancheli, and Gribov are reproduced. In extended models, however, the effects due to quantum numbers and/or alternative unitarization schemes are shown to have a significant effect on the form of absorptive corrections. In particular, explicitly unitary models are given in which (i) the absorptive corrections enhance all cross sections, and (ii) isospin is introduced in a simple way and is found to produce quite different counting rules from those assumed in the Reggeon calculus. It is shown that the internal quantum-number structure of the Pomeron affects the amount of absorption in inclusive cross sections and hence can be experimentally studied. (AIP)

9710 Inelastic eikonal phenomenology in a stationary-phase approximation. Moreno, H.; Fried, H.M. (Departamento de Fisica, Centro de Investigacion y de Estudios Avanzados del Instituto Politecnico Nacional, Apartado Postal 14-740, Mexico 14, D. F.). *Phys. Rev., D;* **12**: No. 7, 2031-2036(1 Oct 1975).

A stationary-phase approximation to a functional-integral representation of model elastic and inelastic pion amplitudes is shown to yield a phenomenology corresponding to the simplest possible unitary model. Possible relevance at CERN ISR energies may be easily tested. (AIP)

9711 Bell's theorem and world process. Stapp, H.P. (Univ. of California, Berkeley). *Nuovo Cim., B;* **29B**: No. 2, 270-276(11 Oct 1975).

The noncausal structure events demanded by Bell's theorem are shown to follow naturally from a theory of events similar to Whitehead's. In spite of this noncausal structure on the level of individual events the macroscopic causality structure observed in nature at the statistical level holds. Quantum theory itself emerges naturally, along with the basic analyticity property of the S-matrix. (auth)

9712 Path-integral formulation of scattering theory. Campbell, W.B.; Finkler, P.; Jones, C.E.; Misheloff, M.N. (Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125). *Phys. Rev., D;* **12**: No. 8, 2363-2369(15 Oct 1975).

A new formulation of nonrelativistic scattering theory is developed which expresses the S matrix as a path integral. This formulation appears to have at least two advantages: (1) A closed formula is obtained for the S matrix in terms of the potential, not involving a series expansion; (2) the energy-conserving δ function can be explicitly extracted using a technique analogous to that of Faddeev and Popov, thereby yielding a closed path-integral expression for the T matrix. The introduction of the concept of the classical interaction picture provides considerable physical insight into this formulation. This formulation also suggests a succession of improvements to the eikonal approximation, the first of which is discussed explicitly. (AIP)

9713 Representations of Reggeon Green's functions: Their scaling form and the approach to scaling. Frazer, W.R.; Moshe, M.

(Department of Physics, University of California, San Diego, La Jolla, California 92037). *Phys. Rev., D;* **12**: No. 8, 2370-2384(15 Oct 1975).

We derive representations for Green's functions in the Reggeon calculus. Our renormalization-group integration method gives the t dependence of the asymptotic scaling functions, as well as the correction terms which are present at nonasymptotic energies. The approach to the scaling form is governed by a critical exponent. The method can be used to calculate the scaling form and the approach to scaling of any n-to-m Reggeon Green's function. We discuss mainly the Pomeron propagator and the three-point function in the one-loop approximation. (AIP)

9714 **Reggeon field theory on a lattice.** Cardy, J.L.; Sugar, R.L. (Department of Physics, University of California, Santa Barbara, California 93106). *Phys. Rev., D;* **12**: No. 8, 2514-2522(15 Oct 1975).

We construct an analog model of interacting Ising spins on a lattice which has the same critical behavior as Reggeon field theory, in the physical number of dimensions. At the critical point the total and elastic cross sections have asymptotic behaviors σ/sub tot/proportional (ln s)$^{-}$/sup gamma/ and σ/sub el/proportional (ln s)$^{-2}$/sup gamma//sup -//subz. By studying the properties of the fixed point of an explicit nonlinear renormalization-group transformation on the lattice, we show that -γless than or equal tozless than or equal to2, so that both the Froissart bound and the constraint σ/sub el/<σ/sub tot/ are satisfied. (AIP)

9715 **Ambiguous sets of partial-wave amplitudes cannot intersect.** Dean, N.W. (Ames Lab., Iowa (USA)). *Nucl. Phys., B;* **97**: No. 3, 377-380(20 Oct 1975).

The correct set of partial-wave amplitudes can sometimes be distinguished from ambiguous ones because it joins continuously, as a function of energy, to a lower-energy set known unambiguously. If two sets intersect, however, this continuity criterion yields no unique answer. It is shown that such an intersection is in fact impossible in the usual experimental spin-0—spin-$^1/_2$ scattering situation. (NL)

NUCLEAR PHYSICS

9716 (COO—1167-36) **Nuclear chemistry research. Progress report, November 1, 1974—October 31, 1975.** Sugarman, N.; Turkevich, A. (Chicago Univ., Ill. (USA)). 31 Oct 1975. Contract E(11-1)-1167. 22p. Dep. NTIS $3.50.

The major effort in the high-energy nuclear chemistry program was the study of cross sections and kinematic properties of products formed from the interaction of 1- to 300-GeV protons with heavy- (Bi and U) and medium-mass (Cu, Ag) nuclei. The products studied ranged in mass from approximately 20 to that of the target nucleus. Except in the case of near-target product nuclei (ΔA approximately 10 to 20), no substantial change in cross section or recoil properties was observed at 300 GeV from those measured at 11.5 GeV. New experiments are in progress to relate the production mechanisms of selected products to fundamental particle interactions and the production of exotic particles. Extensive preparations were made for another experiment to be performed soon at higher intensity on the search for polyneutron aggregates at the LAMPF Accelerator. Work is continuing on the use of stable isotope tracers (methane-20 and 21) for the study of long-range transport and diffusion phenomena in the atmosphere. A collaborative effort on the study of extraterrestrial objects (meteorites and lunar samples) is continuing. The work has involved correlations among trace and minor elements, the evolution of the lunar regolith, differentiation of lunar magmas, and a study of lunar agglutinates. (auth)

9717 (COO—3470-4) **Nuclear reaction studies. Progress report for year ending January 31, 1976.** Alexander, J.M. (State Univ. of New York, Stony Brook (USA). Dept. of Chemistry). 1976. Contract AT(11-1)-3470. 15p. Dep. NTIS $3.50.

Research during 1975 was divided into three sections: I. Studies of the Interaction Barrier, II. Studies of Nuclear Fission, and III. Heavy Ion Reactions. In the first two areas we continue to collaborate with the Bordeaux group of Fleury and Delagrange. In the latter area we are collaborating with the Columbia group of Miller et al. in studies utilizing the Berkeley Superhilac. 3 figures, 1 table. (auth)

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 8614, 8618, 8632, 9900, 9907, 9908, 9915

9718 (BNL-NCS—50451, pp 156-162) **Comments on ^{238}U neutron width evaluations.** Derrien, H. (CEN, Saclay, France). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Two sets of experimental transmission data for ^{238}U are compared. It is indicated that it is possible to improve the evaluation of ^{238}U resonance parameters by checking very carefully the existing sets of experimental data.

9719 (BNL-NCS—50451, pp 189-199) **Interference scattering effects on intermediate resonance absorption at operating temperatures.** Goldstein, R. Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Resonance integrals may be accurately calculated using the intermediate resonance (IR) approximation. Results are summarized for the case of an absorber with given potential scattering cross sections and interference scattering parameter admixed with a non absorbing moderator of given cross section and located in a narrow resonance moderating medium. From the form of the IR solutions, it is possible to make some general observations about effects of interference scattering on resonance absorption. 2 figures. (SDF)

9720 (BNL-NCS—50451, pp 200-203) **Interactive approaches to evaluating methods and data for self-shielded resonance absorption.** Becker, M. (Rensselaer Polytechnic Inst., Troy, NY). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

A variety of options useful in the construction of data files to be compared, applying modifications to a data file, calculating and displaying the consequences of these modifications, etc., have been automated through the Rensselaer Interactive Graphics Analysis System (RIGAS). It is likely that this approach would be desirable for dealing with the self-shielded resonance integral over both resolved and unresolved resonances. (SDF)

9721 (BNL-NCS—50451, pp 204-214) **Effects of the free-gas, slowing-down model on resonance cross sections in ^{238}U.** Karam, R.A. (Georgia Inst. of Tech., Atlanta). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Concentrating on the slowing-down process, it is shown that the free gas model for crystalline ^{238}U would produce large error in the effective broad group resonance cross section. 2 tables, 3 figures. (SDF)

9722 (BNL-NCS—50451, pp 222-254) **ENDF/B-IV thermal reactor lattice benchmark analysis with Monte Carlo resonance treatment.** Rothenstein, W. (Brookhaven National Lab., Upton, NY). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

The results for the TRX benchmarks suggest that the epithermal capture of ^{238}U is overpredicted to some extent by the present ENDF/B-IV data. However, the discrepancy is smaller than was reported in the past and amounts approximately to 0.4 barns of shielded resonance integral. After reduction of the ^{238}U shielded resonance integral by about 0.4 barns quite good agreement of the parameters rho_{28}, $delta_{25}$, $delta_{28}$, and C with experimental values is obtained. These parameters were measured at the center of the core. The values of k/sub eff/ are less than unity, especially for the tightest lattice where the discrepancy remains more than 1 percent. The multiplication factor relates to the assembly as a whole and part of its underprediction may be due to the fact that asymptotic reactor theory in the lattice analysis code is compared with experiments on assemblies with rather small cores. 6 tables, 1 fig. (auth)

9723 **Neutron-diffraction observations on the Cu(Fe) Kondo system.** Dickens, M.H. (Massachusetts Inst. of Tech., Cambridge); Shull, C.G.; Koehler, W.C.; Moon, R.M. *Phys. Rev. Lett.;* **35**: No. 9, 595-598(1 Sep 1975).

Polarized-neutron diffraction studies are reported on a series of dilute Cu(Fe) alloys in which the 3d-electron magnetization induced by an applied magnetic field is sensed in the (111) Bragg reflection. Utilizing the concentration dependence, the isolated-Fe-center magnetization is found to be considerably larger than the total magnetization at temperatures below 10 K. The observations lend support to the development of a Kondo spin-compensated singlet state at low temperature. (auth)

9724 **Absolute intensity measurement in neutron powder diffraction.** Merisalo, M.; Paakkari, T. (Helsinki Univ. (Finland). Dept. of Physics). *J. Appl. Crystallogr.*; **8**: No. 5, 522-524(1 Oct 1975).

Advantages and possibilities of absolute intensity measurements in neutron powder diffraction are discussed. To study experimental techniques, the scale factors of Ni and NH_4Cl have been determined. The present techniques are found to be accurate enough to encourage further studies in this field. (DK)

9725 **Discrete eigenvalue problem for azimuthally dependent transport theory.** Shultis, J.K. (Kansas State Univ., Manhattan, KS); Hill, T.R. *Nucl. Sci. Eng.*; **59**: No. 1, 53-56(Jan 1976).

The discrete eigenvalue problem associated with the one-speed azimuthal Fourier harmonics in plane geometry is discussed. An explicit expression, well-suited to numerical evaluation, is given for the dispersion function, and the reality and maximum number of discrete eigenvalues are demonstrated. From numerical examples, it is found that quite often there are no discrete eigenvalues, particularly for the higher harmonics. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9728, 9767, 9923, 9932

9726 (ORO—4856-26, pp 85-86) **Supermultiplet and cluster structure of nuclei A = 4-10.** Schenzle, D. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9727 (ORO—4856-26, pp 191-192) **Polarization measurements and highly excited states in ^{5}Li.** Seiler, F. (Univ. of California, Berkeley). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Highly excited states in ^{5}Li are investigated by an analysis of ^{3}He(vector d,p)^{4}He data. Their influence is best seen in efficiencies for tensor polarization. It is shown that the analyzing power A/sub yy/ = 1 at 9 MeV and forward angles.

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 9654

9728 (ORO—4856-26, pp 228-229) **Spin dependence of the deuteron optical potential, the deuteron D-state and the Pauli exclusion principle.** Ioanides, A.A.; Johnson, R.C. (Univ. of Surrey, Guildford, Eng.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The effect of the Pauli exclusion principle on the binding energy of a deuteron propagating in nuclear matter has been the subject of renewed interest recently. These calculations have been extended to include the influence of a tensor force component of the neutron-proton interaction of the Yamaguchi type. A consequence of the presence of D-state components in the deuteron is that for a given Fermi momentum and deuteron center-of-mass momentum, k, the deuteron binding energy is found to depend strongly on (s.k), where s is deuteron spin operator. The effect of the Fermi sea is to produce less binding on a deuteron with s.k = 0 than with s.k = +- 1. This can be understood in a simple semi-classical picture in which account is taken of the orbital contribution to s from the deuteron D-state. (auth)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9974

9729 (ORO—4856-26, pp 185-186) **Neutron tunnelling as a mechanism for diproton production in the Sun.** McKee, J.S.C.; Randell, C. (Univ. of Manitoba, Winnipeg, Can.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The neutron tunneling model is shown to indicate that diproton production can be the dominant inelastic channel for the ^{3}He(^{3}He,^{1}He)^{2}He reaction in the solar interior. (auth)

9730 (ORO—4856-26, pp 265-280) **Distorted wave impulse approximation calculations for quasi-free cluster removal reactions.** Chant, N.S.; Roos, P.G. (Univ. of Maryland, College Park). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

An analysis of quasi-free cluster removal reactions is presented taking into account distortion effects. Calculations are carried out using the distorted wave impulse approximation. The alpha cluster removal experiments are considered as examples. 11 figures, 11 references (BJG)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9621, 9764

9731 (BNL-NCS—50446, pp 1-6) **Total helium production cross section for neutron-induced reactions on ^{6}Li for ENDF/B-IV.** Stewart, L.; Hale, G.M. (Los Alamos Scientific Lab., NM). Apr 1975.

In ENDF/B-IV dosimetry file.

Total neutron induced alpha production cross sections below 20 MeV are tabulated for ^{6}Li. The reactions included are (n,t), (n,n'd), and (n,2np). (SDF)

9732 (ORO—4856-26, pp 183-184) **Studies of the ^{2}H(p,2p)n cross sections for constant NN relative energies at 23.0 and 39.5 MeV.** McDonald, A.M. (Univ. of Manitoba, Winnipeg, Canada); Bonbright, D.I.; van Oers, W.T.H.; Watson, J.W.; Rogers, J.G.; Cameron, J.M.; Soukup, J.; Caplan, H.S.; Kloet, W.M.; Tjon, J.A. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9733 (ORO—4856-26, pp 187-188) **(p,2p) and (p,pd) reactions on ^{3}H and ^{3}He at 45 MeV.** Bonbright, D.I.; Elbakr, S.A.; Houdayer, A.; Miller, C.A.; Roberts, D.J.; Tin, E.S.Y.; van Oers, W.T.H.; Watson, J.W. (Univ. of Manitoba, Winnipeg, Can.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9734 (ORO—4856-26, pp 189-190) **^{3}H(p,pn)d quasi-free scattering at 45.4 MeV.** Bonbright, D.I.; Roberts, D.J.; van Oers, W.T.H.; Watson, J.W. (Univ. of Manitoba, Winnipeg, Can.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Data are presented on the angular dependence of quasi-free ^{3}H(p,pn)d scattering at 45.4 MeV. A marked difference between the data and the prediction of the PWIA is noted and related to other measurements of p,pn knockout on light nuclei. (auth)

9735 (ORO—4856-26, pp 195-196) **Cluster structure of A=6 nuclei studied with radiative capture reactions.** Ventura, E. (Rutgers Univ., New Brunswick, NJ). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

There are only four radiative capture reactions available to investigate the structure of the A = 6 nuclei. They are: ^{3}H(^{3}He,γ)^{6}Li; ^{3}He(^{3}He,γ)^{6}Be; ^{3}H(^{3}H,γ)^{6}He; and ^{4}He(d,γ)^{6}Li. Of the above list, only the ^{3}H(^{3}He,γ)^{6}Li and its inverse ^{6}Li(γ,^{3}H)^{3}He have been extensively studied. While the various capture cross sections are in good agreement with each other, serious discrepancies exist between the different photonuclear cross sections measured. However, a recent measurement of the ^{6}Li(γ,^{3}H) cross section shows excellent agreement with the capture cross section and angular distribution data, hopefully establishing the correct cross section for this reaction. (auth)

9736 (ORO—4856-26, pp 301-302) **Proton knock-out reactions, a probe for the cluster sizes in nuclei.** Jain, B.K.; Jain, A.K. (Bhabha Atomic Research Centre, Bombay). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9737 (ORO—4856-26, pp 303-304) **Quasi-free (e,e'x) scattering in ^{6}Li and ^{9}Be.** Genin, J.P.; Julien, J.; Rambaut, M.; Samour, C. (CEN, Saclay, France). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Coincidence measurements of 556 MeV electrons scattered from ^{6}Li and ^{9}Be and of emitted alpha-particles and deuterons have been interpreted in PWIA, assuming cluster preformation. Momentum distributions of clusters in nuclei are deduced. (auth)

9738 (ORO—4856-26, pp 329-344) **Clusters and exotic processes.** Schiffer, J.P. (Argonne National Lab., IL). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Some data is presented which may be construed as indicating that perhaps clusters play a role in high-energy and "exotic" (pion or kaon) interactions with complex (A much greater than 16) nuclei. Some very recent experimental work on pion interactions with nuclei is summarized which may or may not support a picture in which clusters play an important role. (14 references) (auth)

9739 (ORO—4856-26, pp 363-364) **Nuclear substructure in some dissociations of light nuclei by protons at 600 MeV and 24 GeV.** Berthot, J. (Univ., Clermont, France); Fain, J.; Gardes, J.; Meritet, L.; Querrou, M.; Vazeille, F.; Ille, B. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9740 **Polarization effects in the final-state interaction region of the p—d breakup reaction.** Rad, F.N.; Conzett, H.E.; Roy, R.; Seiler, F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.*; **35**: No. 17, 1134-1136(27 Oct 1975).

The angular distributions of the vector analyzing power have been measured in the reactions ^{2}H(p,p) np and ^{1}H(d,p) np at 22.7 and 45.4 MeV, respectively, corresponding to the same center-of-mass energy. Significant analyzing powers were found in the production of final-state np pairs with low relative energies, and the angular distributions show a remarkable similarity to those of the corresponding elastic scattering. (AIP)

9741 **Polarization in neutron-proton scattering at 29.6 MeV.** Eldred, R.A.; Bonner, B.E.; Cahill, T.A. (Crocker Nuclear Laboratory and the Department of Physics, University of California, Davis, California 95616). *Phys. Rev., C;* **12**: No. 6, 1717-1722(Dec 1975).

The polarization in neutron-proton scattering at 29.6 MeV was deduced from asymmetries measured at every 10 degree c.m. from 50 to 150 degree c.m. The incident neutron beam was derived from a high-pressure deuterium gas cell via the ^{2}H(d, n)^{3}He reaction at 37 degree c.m. The beam passed through a spin rotation magnet and, at the target location 5.4 m from the gas cell, possessed a flux of 5 times 10^{5} n/sec and a polarization of 0.32 plus-or-minus 0.04. Data between 50 and 110 degree c.m. were obtained using scintillating CH target in coincidence with neutron detectors, while data between 120 and 150 degree c.m. were obtained using recoil protons from a CH_2 target. Total errors in the derived polarizations ranged from plus-or-minus 0.007 to plus-or-minus 0.022. These data agree very well with three previous values measured near 30 MeV at Los Alamos, but they disagree with Harwell data indicating small or negative polarizations near 150 degree c.m. The present results agree well with predictions of the Livermore X and Yale IV phase shift sets, but slightly favor the former. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 9747

RADIOACTIVE DECAY

9742 **Second class interactions and the electron-neutrino correlation in nuclear beta decay.** Calaprice, F.P. (Department of Physics, Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). *Phys. Rev., C;* **12**: No. 6, 2016-2021(Dec 1975).

The electron-neutrino correlation for ^{6}He β decay is analyzed for possible second class effects. Existing data are found to be consistent with there being no second form factor but the conclusion is somewhat model dependent. The $e\nu$ correlation for the ^{19}Ne decay is considered and it is shown that an improved measurement, comparable to that achieved for ^{6}He, would provide an unambiguous result concerning second class terms. (AIP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9767, 9934, 9937, 9939

9743 (ORO—4856-26, pp 71-72) **Study of the alpha-clustering structure of ^{20}Ne based on the resonating group method for ^{16}O+α.** Matsuse, T. (Kyoto Univ.); Kamimura, M.; Fukushima, Y. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9744 (ORO—4856-26, pp 73-74) **Structure study of T=0 levels in ^{16}O by ^{12}C + α cluster-coupling model.** Suzuki, Y. (Niigata Univ., Japan). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9745 (ORO—4856-26, pp 75-76) **Role of particle-hole interaction in the four-particle-four-hole states in ^{16}O.** Takada, K.; Tazaki, S. (Kyushu Univ., Fukuoka). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9746 (ORO—4856-26, pp 79-80) **Alpha cluster structure of 0^{+}_{2} state of ^{12}C.** Uegaki, E. (Hokkaido Univ., Sapporo); Okabe, S.; Abe, Y.; Tanaka, H. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9747 **Asymmetry of mirror γ decays in ^{13}C and ^{13}N.** Kurath, D. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.*; **35**: No. 22, 1546-1547(1 Dec 1975).

An explanation is offered for the large difference in B (E1) values of mirror transitions from $1/2^{+}$ state to the ground state, based on the difference in binding energy of the $1/2^{+}$ states. The binding energy determines the degree of coupling of the positive parity nucleon to the deformed ^{12}C core, which in turn affects the B (E1) value. The experimental asymmetry can be satisfied with a small change of the wave function. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9730, 9743, 9776, 9961

9748 (ORO—4856-26, pp 81-82) **Electron scattering form factors for ^{12}C in a molecular-orbital model.** Okabe, S. (Hokkaido Univ., Sapparo); Abe, Y. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9749 (ORO—4856-26, pp 83-84) **Three-alpha model of ^{12}C.** Horiuchi, H. (Kyoto Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9750 (ORO—4856-26, pp 156) **Microscopic calculations for the different behavior of the two oxygen isotopes ^{16}O and ^{18}O in respect to the elastic backward scattering of α particles.** Suenkel, W.; Wildermuth, K. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9751 (ORO—4856-26, pp 159) **Symmetry test in the reactions t + ^{9}Be yields ^{6}Li + ^{6}He, ^{6}Li* (T=1) + ^{6}He.** von Oertzen, W. (Hahn-Meitner-Institut, Berlin); Flynn, E. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9752 (ORO—4856-26, pp 162) **Multiple scattering corrections to the p-^{12}C optical potential with Cohen—Kurath wavefunctions.** Ahmad, K.; Johnson, R.C. (Univ. of Surry, Guildford, Eng.). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9753 (ORO—4856-26, pp 163-164) **Role of particle-exchange in the ^{16}O-α scattering studied by the resonating group treatment.** Matsuse, T. (Kyoto Univ.); Kamimura, M.; Fukushima, Y. 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9754 (ORO—4856-26, pp 193-194) **Effects of intercluster exchange of particles on photonuclear reaction in ^{6}Li.** Lodhi, M.A.K.; Wood, K.E. (Texas Tech Univ., Lubbock). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
The bremsstrahlung-weighted cross section for the photodisintegration of ^{6}Li is calculated to study the effect of the exchange of particles between the alpha and deuteron clusters. (auth)

9755 (ORO—4856-26, pp 230-231) **Spin-orbit coupling for ^{6}Li scattering and (α + d) clustering.** Thompson, W.J. (Univ. of North Carolina, Chapel Hill). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9756 (ORO—4856-26, pp 232-233) **Microscopic study of α - ^{6}Li elastic scattering.** Remaud, B.; Laskar, W. (Univ., Nantes, France). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
Initial results are presented for theoretical phase shifts for α—^{6}Li elastic scattering, calculated using the resonating group method, including a completely antisymmetrized wave function. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

9757 **(^{9}Be, ^{8}B) reaction and the unbound nuclide ^{10}Li.** Wilcox, K.H.; Weisenmiller, R.B.; Wozniak, G.J.; Jelley, N.A.; Ashery, D.; Cerny, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Lett., B;* **59**: No. 2, 142-144(27 Oct 1975).
Counter-telescope and recoil-coincidence techniques were employed to study the ^{9}Be(^{9}Be,^{8}B)^{10}Li reaction at 121 MeV. A cross section of approximately 30 nb/sr (c.m.) was observed, and a ^{10}Li mass excess of 33.83 +- 0.25 MeV was indicated. This corresponds to ^{10}Li being unbound to ^{9}Li + n by 0.80 +- 0.25 MeV. (NL)

RADIOACTIVE DECAY

9758 (ORO—4856-26, pp 197-198) **States of carbon-12 by proton scattering from boron-11 (Ep = 3 ... 8 MeV).** Boerchers, F.; Krug, J.; Kamke, D. (Ruhr-Univ., Bochum, Ger.). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9759 **Experimental study of weak magnetism and second-class interaction effects in the β decay of polarized ^{19}Ne.** Calaprice, F.P.; Freedman, S.J.; Mead, W.C.; Vantine, H.C. (Department of Physics, Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). *Phys. Rev. Lett.;* **35**: No. 23, 1566-1570(8 Dec 1975).
The angular distribution of positrons emitted in the decay of polarized ^{19}Ne has been measured as a test for the second-class weak interaction. The β asymmetry parameter varies linearly with the β energy with slope (dA/dE)/sub exp/= (-0.65plus-or-minus0.15) % MeV^{-1}. This result requires a second-class form factor comparable to the weak-magnetism term. (AIP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9735, 9758, 9767, 9784, 9786, 9793, 9794, 9800, 9801, 9803, 9934, 9940

9760 (ORO—4856-26, pp 199-200) **Alpha emission from some excited states in carbon-12.** Krug, J.; Seifert, K.H.; Kamke, D. (Ruhr-Univ., Bochum, Ger.). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
The ^{11}B(p,α_1)^{8}Be (2.9) reaction is examined in the energy range between 17.2 and 20.6 MeV in order to study some excited states of ^{12}C. (BJG)

9761 (ORO—4856-26, pp 435-436) **Angular correlation study of some ^{16}O highly excited levels.** Foti, A. (Instituto di Fisica Nucleare, Cantania, Italy); Pappalardo, G.; Strazzeri, A.; Avril, M.; Lepareux, M.; Saunier, N. 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
Spin, parity and α-decay properties of some ^{16}O highly excited levels (at 16.3, 20.9, and 21.8 MeV) have been measured by means of the particle-particle angular correlation method applied to the ^{12}C(^{6}Li,d)^{16}O* yields α + ^{12}C reaction; the deuterons were detected at 0' by means of a magnetic spectrometer. (auth)

9762 (ORO—4856-26, pp 526-527) **Resonances in the ^{12}C+^{12}C system.** Castro, J.J.; Federman, P. (Instituto Politecnico Nacional, Mexico City). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9763 (ORO—4856-26, pp 540-541) **Resonances in inelastic ^{12}C+^{16}O scattering.** Malmin, R.E.; Paul, P. (SUNY, Stony Brook, NY). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9764 **M1 decay rates and second-class currents in mass 8.** Nathan, A.M.; Garvey, G.T.; Paul, P.; Warburton, E.K. (Princeton University, Princeton, New Jersey 08540). *Phys. Rev. Lett.;* **35**: No. 17, 1137-1140(27 Oct 1975).
The total isovector M1 γ-decay rate of the 16.6—16.9-MeV doublet in ^{8}Be to the broad first excited state has been measured with the reaction ^{4}He(^{4}He,γ). A width of 4.8+-0.7 eV has been found. When properly interpreted, this result seems consistent with predictions of conserved vector current theory and with the absence of a second-class induced-tensor form factor. (AIP)

9765 **Energy levels of ^{12}B.** Ajzenberg-Selove, F.; Middleton, R.; Garrett, J.D. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., C;* **12**: No. 6, 1868-1872(Dec 1975).
The ^{9}Be(^{7}Li,α)^{12}B reaction has been studied at E (^{7}Li) =20 MeV using a multiangle spectrograph. Thirty-seven states of ^{12}B with E/subx/ < 14 MeV have been observed. Angular distributions are presented for the first seven states of ^{12}B. The neutron reduced widths extracted from experimental total widths of the positive parity states are compared with shell-model predictions. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9621, 9736, 9737, 9738, 9757, 9758, 9761, 9763, 9765, 9808, 9809, 9810, 9812

9766 (BNL-NCS—50446, pp 7-13) **Total helium production cross section from n + ^{10}B interactions for ENDF/B-IV.** Young, P.G.; Hale, G.M. (Los Alamos Scientific Lab., NM). Apr 1975.
In ENDF/B-IV dosimetry file.
The total neutron-induced alpha production cross section for ^{10}B was derived by summing the cross sections from the reactions (n,α_0)^{7}Li, (n,α_1)^{7}Li*(478 keV), and (n,n'α)^{6}Li plus twice the reactions (n,t2α), (n,n'd2α), and (n,2np2α). (SDF)

9767 (ORO—4856-26, pp 201-202) **Narrow potential resonances in light nuclei.** Fick, D.; Huther, P.; Kilian, K.; Niewisch, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9768 (ORO—4856-26, pp 242-264) **Survey of quasi-free cluster knockout.** Roos, P.G.; Chant, N.S. (Univ. of Maryland, College Park). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
The investigation of quasi-free knockout reactions has been proceeding for many years now, since the first experiments studying (p,2p) reactions on light nuclei. These experiments clearly showed the dominance of quasi-free proton knockout, and have provided information on the proton holes states in nuclei. From very early in the game people extended these studies to the knockout of clusters, in an attempt to obtain nuclear structure information about clustering in nuclei. These cluster knockout reactions, excluding the nucleon knockout work, are examined. 20 figures, 16 references (auth)

9769 (ORO—4856-26, pp 295-296) **^{6}Li --greater than α+d vertex from the ^{6}Li(p,pd)α reaction at 156 and 590 MeV.** Prats, F.; Ghovanlou, A.; Lehman, D.R. (George Washington Univ., Washington, DC). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9770 (ORO—4856-26, pp 305-306) **^{12}C(p,pd)^{10}B reaction at 75 MeV.** Grossiord, J.Y.; Guichard, A.; Gusakow, M.; Pizzi, J.R. (Univ., Lyon). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
An attempt was made to investigate deuteron clustering in nuclei. The excitation spectrum obtained by adding the results of three angular correlations over an energy width of 20 MeV is illustrated. Four states of ^{10}B are observed. (CES)

9771 (ORO—4856-26, pp 307-308) **Role of quasifree processes in 14.4 MeV neutron-induced multiparticle breakup on light nuclei.** Antolkovic, B.; Turk, M. (Institut Rudjer Boskovic, Zagreb). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
An experimental study of the n + ^{6}Li yields alpha + d + n and n + ^{10}B yields $\alpha + \alpha$ + d + n reactions at 14.4 MeV gave indication on the presence of quasifree (QF) processes. No contribution of the QF process was found in the reaction n + ^{10}B yields $\alpha + \alpha$ + t. (auth)

9772 (ORO—4856-26, pp 311-312) **Analysis of the cluster structure of ^{6}Li using the (p,pα) and (p,p tau) reactions.** Goldberg, D.A.; Roos, P.G.; Chant, N.S.; Woody, R. III. (Univ. of Maryland, College Park). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
The cluster structure of ^{6}Li is analyzed using the reactions ^{6}Li(p,pα)BQ2H and Ei(p,ptau) H. A set of kinematically complete experiments was performed at seven so-called quasi-free angle pairs, i.e., angle pairs for which zero recoil momentum for the residual nucleus is kinematically allowed; data at four such angle pairs was taken for the (p,pα) reaction and three for the (p,ptau). The results were analyzed using the impulse approximation. (auth)

9773 (ORO—4856-26, pp 317-318) **Quasi-free scattering and reaction in ^{7}Li(p,pd)^{4}He, ^{7}Li(p,pt)^{4}He and ^{7}Li(p,dd)^{4}He reactions at 100 MeV.** Chang, C.C.; Bhowmik, R. (Univ. of Maryland, College Park). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
The (p,pd), (p,pt) and (p,dd) reactions on ^{7}Li were studied at E/sub p/ = 100 MeV. Most of the data were taken with symmetric geometry. A non-symmetric angle pair was chosen which corresponds to zero recoil momentum of the ^{4}He nucleus for both the ^{7}Li(p,pt)^{4}He and ^{7}Li(p,dd)^{4}He reactions. This pair of angles is called the double quasi-free angle. (auth)

9774 (ORO—4856-26, pp 319-320) **Spectroscopic investigation of the (α,2α) reaction.** Sherman, J.D.; Hendrie, D.L.; Zisman, M.S. (Univ. of California, Berkeley). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
Nine target nuclei ^{12}C, ^{16}O, ^{24,26}Mg, ^{28,30}Si, ^{40,44}Ca, and ^{66}Zn have been studied by the (α,2α) reaction with an incident alpha beam energy of 90 MeV. Energy resolution of 250-300 keV (FWHM) permitted identification of many excited states, although the ground state transitions were dominant. The ground state angular correlation cross section magnitudes decreased a factor of ten from ^{12}C to ^{66}Zn. In all cases the data appear to be consistent with a quasifree α-α collision description of the reaction process. (auth)

9775 (ORO—4856-26, pp 321-322) **(α,2α) nuclear reaction and the cluster structure of light nuclei.** Kudo, Y. (Osaka City Univ.); Honda, T. 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
In addition to the ordinary direct knock-out process (DK process of the (α,2α) reaction, the core knock-out process (CK process) is also investigated by the plane wave impulse approximation (PWIA). Numerical calculations are made for the ^{7}Li(α,2α)^{3}H reaction of 55 MeV incident energy by taking into account in detail the cluster structure of ^{7}Li. (auth)

9776 (ORO—4856-26, pp 323-324) **^{12}C(α,2α)^{8}Be(g.s.) reaction at low energies and the quasi-elastic mechanism.** Cowley, A.A.; Heymann, G. (CSIR, Pretoria). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
The reaction ^{12}C(α,2α)^{8}Be was studied at energies between 23.3 and 33.5 MeV. The energy dependence of off-energy-shell α-α cross sections was extracted and compared with theory. The disagreement obtained casts some doubt on previous interpretations of the mechanism of this reaction at low energies. (auth)

9777 (ORO—4856-26, pp 346-347) **Charged particle emission following bombardment of nickel with ^{220}MeV π^{+}.** Amann, J.F.; Barnes, P.D.; Doss, M.; Dytman, S.A.; Eisenstein, R.A.; Penkrot, J.; Thompson, A. (Carnegie—Mellon Univ., Pittsburgh). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
In several recent studies of reactions induced with stopped kaons and pions as well as in-flight pions and protons, the observed singles gamma ray spectra have been discussed in terms of the removal of one or more "α clusters". Cross sections for such processes as large as 100 mb have been inferred in some cases for pion bombardment. Recently, calculations of particle evaporation spectra were compared with measured proton induced gamma ray spectra and were brought into agreement only when a pre-equilibrium mechanism was introduced. (auth)

9778 (ORO—4856-26, pp 348-349) **γ rays from proton bombardment of nuclei.** Artun, O. (CEN, Saclay, France); Cassagnou, Y.; Legrain, R. 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
γ rays from nuclei bombarded by high energy protons (from 100 MeV to 1 GeV) lead to mass distributions of stable nuclei where 4n-nuclei are the most abundant. With calcium an energy dependence is found. Some evidence for direct or semi-direct processes is reported. (auth)

9779 (ORO—4856-26, pp 352-353) **Cluster aspects of nuclei in pion-absorption processes.** Engelhardt, H.D.; Lewis, C.W.; Ullrich, H.; Boschitz, E.T. (CERN, Geneva). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.
Absorption of stopped negative pions on ^{10}B, ^{16}O, ^{19}F, ^{31}P, ^{40}Ca and ^{93}Nb was investigated by in-beam gamma spectroscopy of residual nuclei. Removal of nucleon numbers compatible with substructures of 3N or alpha-clusters from most targets was found to be comparable in relative yields with that of two-nucleon removal. Removal of (4p,4n) was observed only with Ca and P as target nuclei, these processes being not dominant in contrast to multi-alpha removal reported with Ca as a target at higher pion energies. (auth)

9780 (ORO—4856-26, pp 362) **Threshold pion production in pion-nucleus collisions: a simple estimate.** Rockmore, R. (Rutgers-the State Univ., New Brunswick, NJ). 1975.
From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).
In Clustering phenomena in nuclei: II.

9781 (ORO—4856-26, pp 367-391) **Nuclear spectroscopy with multinucleon transfer.** von Oertzen, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

In this survey attention is focused on specific problems and successes encountered in multinucleon transfer. The subject is divided into four sections: two-nucleon transfer, three-nucleon transfer, four-nucleon transfer, and alpha-particle reactions involving ^{6}Li or ^{7}Li in the initial or final channel. 20 figures, 33 references. (BJG)

9782 (ORO—4856-26, pp 392-406) **Recent multinucleon transfer experiments with heavy ions at Berkeley.** Harvey, B.G. (Univ. of California, Berkeley). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A review of two-, three-, four-, and multi-nucleon transfer reaction experiments at Berkeley and their relation to clustering is given. 13 figures, 23 references. (BJG)

9783 (ORO—4856-26, pp 413-414) **Alpha-particle pick-up reactions in the 1p and 1d2s shells.** Molen, A.V.; Janecke, J.; Becchetti, F.D. (Univ. of Michigan, Ann Arbor). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The ^{12}C(d,^{6}Li)^{8}Be, ^{16,18}O(d,^{6}Li)^{12,14}C, ^{20,22}Ne(d,^{6}Li)^{16,18}O and ^{40}Ca(d,^{6}Li)^{36}Ar reactions have been studied at E/sub d/ = 35 MeV. The results are in good overall agreement with simple SU_3 shell-model predictions. (auth)

9784 (ORO—4856-26, pp 415-416) **Study of ^{16}O with four-particle transfer reactions.** Pilt, A.A.; Cornell, J.C.; Fisher, P.S.; Menchaca-Rocha, A.; Millener, D.J.; Sinclair, D.; Scott, D.K. (Oxford Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Levels in ^{16}O have been studied with the four-particle transfer reactions ^{12}C(^{11}B,^{7}Li)^{16}O, ^{12}C(^{12}C,^{8}Be)^{16}O, ^{12}C(^{16}O,^{12}C)^{16}O and ^{12}C(^{20}Ne,^{16}O)^{16}O using high energy (approximately 110 MeV) heavy ion beams from the Harwell VEC. The reaction products were detected and identified with counter telescopes, giving typically 600 keV overall resolution. (auth)

9785 (ORO—4856-26, pp 419-420) **(p,^{6}Li) nuclear reaction and cluster structure of light nuclei.** Kudo, Y. (Osaka City Univ.); Honda, T.; Horie, H. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Differential cross sections for the (p,^{6}Li) reactions for the target nuclei ^{11}B, ^{12}C, ^{16}O and ^{19}F have been measured at an incident proton energy of 52 MeV using the INS-Tokyo FM cyclotron.

9786 (ORO—4856-26, pp 421-422) **^{12}C(^{14}N,^{13}C)^{13}N (2.37,1/2^{+}) and ^{12}C(^{10}B,^{9}Be)^{13}N(2.37,1/2^{+}) reactions and the structure of the 2.37 MeV state in ^{13}N.** Nair, K.G.; Hamm, M.; Towsley, C.; Nagatani, K. (Texas A and M Univ., College Station). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Heavy ion induced proton transfer reactions are used to populate low-lying levels in ^{13}N. Angular distributions to the 2.37 MeV state in ^{13}N show anomalies which perhaps may be due to possible collective components in this previously assumed pure single particle 2s/sub $^{1}/_{2}$/ orbit. (auth)

9787 (ORO—4856-26, pp 423-424) **Cluster aspects of multinucleon transfer reactions.** Nair, K.G.; Hamm, M.; Towsley, C.W.; Hanus, R.; Nagatani, K. (Texas A and M Univ., College Station). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Three- and four-nucleon transfer reactions in light elements induced by high energy ^{14}N and ^{10}B beams are investigated with a view to extracting spectroscopic information on cluster states. The high selectivity for populating states with predominant cluster structure in the residual nuclei for these reactions is emphasized. (auth)

9788 (ORO—4856-26, pp 425-426) **Direct 5-nucleon-transfer in the reactions ^{10,11}B(^{14}N,^{9}Be)^{15,16}O and ^{12}C(^{14}N,^{9}Be)^{19}F.** Klapdor, H.V.; Reiss, H.; Rosner, G.; Schrader, M.; Ford, J.L.C. Jr.; Thornton, S.T. (Max-Planck-Institut fuer Kernphysik, Heidelburg). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9789 (ORO—4856-26, pp 427-428) **Double exchange of particles in heavy ion reactions.** Pham, D.L. (Institut de Sciences Nucleaires, Grenoble, France). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A model is presented to study a reaction where there are particles transferred simultaneously from the projectile to the target as well as from the target to the projectile. The ^{12}C(^{6}Li,^{6}He)^{12}N reaction at E/sub L/ = 31.8 MeV is taken as an example and good agreement with the data is obtained. (auth)

9790 (ORO—4856-26, pp 429-430) **(p,α) reactions on light nuclei.** Buck, W.; Schenk, K.; Staebler, A.; Staudt, G. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

As part of a program to study the mechanism of (p,α) reactions on light nuclei, angular distributions and excitation functions of the reactions ^{6}Li(p,^{3}He)^{4}He, ^{11}B(p,α)^{8}Be and ^{19}F(p,α)^{16}O have been investigated from E/sub p/ = 6 to 20 MeV. The experiments have been done at the tandem accelerators in Erlangen and Heidelberg. (auth)

9791 (ORO—4856-26, pp 431-432) **^{16}O(α,p)^{19}F and ^{12}C(α,p)^{15}N reactions at E/sub α/ = 40 MeV.** van der Woude, A.; van der Borg, K.; de Meijer, R.J. (Univ., Groningen, Netherlands). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The ^{16}O(α,p)^{19}F and ^{12}C(α,p)^{15}N reactions at E/sub α/ = 40 MeV are studied with the analyzed beam of the K.V.I. cyclotron. Representative spectra at THETA/sub L/ = 15° are shown in Fig. 1. The selectivity of the reaction is clearly demonstrated: In both reactions only a few levels at high excitation energies are strongly excited. (auth)

9792 (ORO—4856-26, pp 524-525) **Study of the ^{12}C(α,^{8}Be)^{8}Be reaction.** Brochard, F.; Chevallier, P.; Disdier, D.; Rauch, V.; Rudolf, G.; Scheibling, F. (Centre de Recherces Nucleaires, Strasbourg). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The ^{12}C(α,^{8}Be)^{8}Be reaction has been studied in the energy range E/sub alpha/ = 27—33 MeV. Analysis of angular distributions measured from E/sub alpha/ = 12.5 MeV to 33 MeV allows the extraction of the total cross section corresponding to the dominant l. Hauser—Feshbach calculations may explain the large structures observed. (auth)

9793 (ORO—4856-26, pp 530-531) **Spin assignment of J/sup π/ = 12^{+} for the ^{12}C + ^{12}C resonance at E/sub ^{12}C/(c.m.) = 18.5 MeV.** Bernhardt, K.G. (Univ. of Washington, Seattle); Eberhard, K.A.; Weidinger, A. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

In an effort to obtain a more precise picture of the recently observed resonances in excitation functions for ^{12}C(^{12}C,α)^{20}Ne, ^{10}B(^{14}N, α)^{20}Ne and ^{12}C(^{12}C, ^{8}Be)^{16}O at excitation energies in the region of 30 to 40 MeV in the corresponding compound nucleus ^{24}Mg, angular distributions in this energy range have been measured for the ^{12}C(^{12}C,^{8}Be)^{16}O reaction.(auth)

9794 (ORO—4856-26, pp 532-533) **Study of molecular resonances in ^{12}C—^{12}C and ^{12}C—^{16}O scatterings by Imanishi model.** Kondo, Y.; Matsuse, T.; Abe, Y. (Kyoto Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9795 (ORO—4856-26, pp 309-310) **Quasi-elastic scattering of 600 MeV protons by alpha clusters in light and medium nuclei.** Anne, R. (CEA, Saclay, France); Delpierre, P.; Devaux, A.; Kahane, J.; Landaud, G.; Sene, R.; Yonnet, J. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Alpha knock out from light and medium nuclei up to ^{40}Ca was investigated. Preliminary values of the differential cross sections (dsigma/dΩ_1 dΩ_2 dE) are given for ^6Li and ^{12}C nuclei. The P/sub R/ recoil momentum distributions show a maximum at p/sub R/ = 0. (auth)

9796 (ORO—4856-26, pp 433-434) **Cluster structure of the ^9Be nucleus from the $^9Be(n,\alpha)^6He$ reaction.** Smolec, W.; Burzynaski, S.; Rusek, K.; Turkiewicz, I.; Turkiewicz, J.; Zupranski, P. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9797 **$^6Li(\alpha,2\alpha)^2H$ reaction at 700 MeV and the α-d momentum distribution.** Dollhopf, W.; Perdrisat, C.F. (College of William and Mary, Williamsburg, Va. (USA). Dept. of Physics); Kitching, P.; Olsen, W.C. (Alberta Univ., Edmonton (Canada). Nuclear Research Centre). *Phys. Lett., B;* **58**: No. 4, 425-427(29 Sep 1975).

The results of an experimental study of the reaction $^6Li(\alpha,2\alpha)^2H$ at 700 MeV are given. A comparison with the data from seven other reactions pertaining to the α+d cluster structure of ^6Li is presented. The amplitude for the virtual transition ^6Li yields α + d obtained in three of these experiments and the present one are comparable. The internal momentum distributions extracted with the plane-wave impulse approximation in four of the experiments are compatible with a pole form, the width parameter being given by the α-separation energy in ^6Li. The remarkable consistency among these results is seen as evidence for the validity of the simple models used for both the reaction mechanism (PWIA) and the α—d vertex (pole approximation) in ^6Li. (NL)

9798 **Absolute cross sections for pion reactions on light nuclei at the (3,3) resonance.** Karol, P.J.; Yester, M.V.; Klobuchar, R.L.; Caretto, A.A. Jr. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Chemistry). *Phys. Lett., B;* **58**: No. 4, 489-490(29 Sep 1975).

Absolute cross sections for pion-induced neutron knockout reactions and some more complex reactions on ^{14}N, ^{16}O, ^{19}F and ^{31}P were determined by activation at 190 MeV. Results are consistent with existing spallation models as modified by the recent final-state interaction theory of Sternheim and Silbar. (NL)

9799 **Study of the reaction $^{12}C + ^{13}C$ yields $\alpha + ^{21}Ne$.** Hallock, J.N.; Enge, H.A. (Massachusetts Inst. of Tech., Camb09idge (USA). Dept. of Physics); Garrett, J.D.; Middleton, R.; Fortune, H.T. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). *Nucl. Phys., A;* **252**: No. 1, 141-151(3 Nov 1975).

The reaction $^{12}C + ^{13}C$ yields $\alpha + ^{21}Ne$ has been investigated at c.m. bombarding energy of 14.5 MeV by using beams of both ^{12}C and ^{13}C. The α-particle reaction products were recorded by using a multiple-angle spectrograph. Seventy-six levels were observed below 12.56 MeV in ^{21}Ne; 28 levels from 9.42 to 12.56 MeV are reported for the first time. The data are consistent with a compound-nucleus reaction mechanism. (NL)

9800 **How important are two-step processes in $^{16}O(^3He, d)^{17}F$.** Fortune, H.T.; Medsker, L.R.; Garrett, J.D.; Bingham, H.G. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., C;* **12**: No. 6, 1723-1725(Dec 1975).

Angular distributions were measured for the $^{16}O(^3He, d)^{17}F$ reaction leading to the first four states of ^{17}F. Comparison with distorted-wave Born-approximation (DWBA) calculations yields spectroscopic factors of 0.94 and 0.83 for the ground and first-excited states, respectively. Comparison with unbound DWBA predictions calculated from the known proton widths of the next two states indicates the presence of a large two-step component for population of the $1/2^-$ state and possibly of the $5/2^-$ state. (AIP)

9801 **Angular distribution measurements for $^{14}C(d, p)^{15}C$ and the level structure of ^{15}C.** Goss, J.D.; Jolivette, P.L.; Browne, C.P.; Darden, S.E.; Weller, H.R.; Blue, R.A. (Department of Physics, University of Nortre Dame, Notre Dame, Indiana 46556). *Phys. Rev., C;* **12**: No. 6, 1730-1738(Dec 1975).

A 14 MeV deuteron beam was used to measure the angular distributions the $^{14}C(d, p)^{15}C$ reaction leading to the two bound states and eight of the unbound states of ^{15}C. Vector analyzing powers were measured for the elastic scattering and for the two bound states. Distorted wave Born approximation calculations were performed and spectroscopic factors were obtained for the two bound states. Calculations for stripping to unbound states using a resonance form factor and following the approach of Vincent and Fortune were compared with the angular distribution data of the unbound states to obtain values of J, π, and neutron width Γ/subn/. A strong J dependence occurs in the calculated cross sections for stripping to unbound states. (AIP)

9802 **Experimental studies of the resonance at E/sub c.m./ = 19.7 MeV in the $^{12}C + ^{16}O$ system.** Shapira, D.; Stokstad, R.G.; Sachs, M.W.; Gobbi, A.; Bromley, D.A. (Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut). *Phys. Rev., C;* **12**: No. 6, 1907-1917(Dec 1975).

A resonance appearing in the $^{12}C + ^{16}O$ system at a center-of-mass incident energy of 19.7 MeV has been studied experimentally. Excitation functions for the $^{12}C + ^{16}O$ inelastic scattering and the $^{12}C(^{16}O, \alpha)^{24}Mg^*$ and $^{12}C(^{16}O, p)^{27}Al^*$ reaction channels were measured. The width of the resonance was shown to be more than double the average level width in ^{28}Si at excitation energies around 36.5 MeV where this resonance appears. The resonance is enhanced at large angles in the elastic and inelastic channels and it is found to be equally strong at θ/sub c.m./ = 3degree and 177degree for the $^{12}C(^{16}O, p)^{27}Al$ reaction. The yield of 6.13 MeV γ radiation has been measured and is observed to resonate at E/sub c.m./ = 19.7 MeV. High resolution measurements of the particle yield at E/sub c.m./ = 19.7 MeV, θ/sub lab/ = 7.5degree for the reaction $^{12}C(^{16}O, ^{12}C)^{16}O^*$ (6.05, 6.13 MeV) show that the 3^- (6.13 MeV) state is populated much more strongly than the 0^+ (6.05 MeV) state. These results do not support the suggestion that the resonance has a ^{12}C-α-^{12}C molecular structure. Measurements of inelastic scattering at higher energies suggest the existence of additional correlated structures. A statistical analysis of the α-particle lds indicates that both compound and direct mechanisms contribute to the reaction. A discussion of the properties of the resonance in terms of intermediate structure and the statistical theory of Moldauer is given. (AIP)

9803 **Analysis of the $^{12}C(^6Li,\alpha)^{14}N$ reaction for E (^6Li) = 33 MeV.** White, R.L.; Charlton, L.A.; Kemper, K.W. (Physics Department, Florida State University, Tallahassee, Florida 32306). *Phys. Rev., C;* **12**: No. 6, 1918-1926(Dec 1975).

The $^{12}C(^6Li,\alpha)^{14}N$ reaction to the first eight T = 0 states was studied at E (^6Li) = 33 MeV in the angular range 12.5degree less than or equal to θ less than or equal to 165degree. The measurements for the positive parity states in ^{14}N also included the angular range 2.5degree—12.5degree. Calculations for the angular distributions were done within the framework of the distorted-wave Born approximation (DWBA) with three different prescriptions: (1) zero range two particle transfer, (2) finite range deuteron cluster transfer, and (3) finite range two particle transfer, which included a full microscopic description of the two nucleon wave function. None of the three types of DWBA calculations could reproduce the data. Consequently, the possiblity of multistep contributions was investigated by computing the spectroscopic amplitudes for transitions from the 2^+ first excited state in ^{12}C to the first two states in ^{14}N. It was found that the transfer strengths from the ^{12}C (4.43 MeV) to the ^{14}N (0.00 MeV) and ^{14}N (3.95 MeV) J/sup pi/ = 1^+ levels are larger than those from the ^{12}C ground state. These results coupled with previous results showing that the $^{12}C(^6Li,\alpha)^{14}N$ reaction is not compound at this energy imply that multistep mechanisms may be very important. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

RADIOACTIVE DECAY

9804 **Beta recoil effects in the delayed alpha decay of ^{20}Na.** Macfarlane, R.D.; Oakey, N.S. (Niels Bohr Inst., Copenhagen). *Bull. Acad. Sci. USSR, Phys. Ser.;* **34**: No. 10, 1880-1883(Oct 1970).

From 20. annual conference on nuclear spectroscopy and nuclear structure; Leningrad, USSR (28 Jan 1970).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: No. 10, 2109-2112(Oct 1970).

A recent study of the alpha spectrum of ^{23}Na under conditions of high energy resolution is reported from which one can obtain directly from the alpha spectrum a partial level scheme. In addition it is possible to obtain beta decay Q values and some qualitative information on β^+ - ν correlations from the measured shapes of the individual alpha lines. The line broadening is also discussed. (JFP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9804, 9807, 9934

9805 (ORO—4856-26, pp 69-70) **Structure of intrinsic states of K/sup π/=0^+ bands in ^{20}Ne.** Nemoto, F. (Kyoto Univ.); Yamamoto, Y.; Horiuchi, H.; Suzuki, Y.; Ikeda, K. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9730, 9828

9806 (ORO—4856-26, pp 236-237) **Two-cluster structure of some alpha-scattering resonances in the sd shell.** Budzanowski, A.; Grotowski, K.; Strzalkowski, A. (Jagellonian Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The excitation functions of the elastic scattering of alpha particles at backward angles on ^{24}Mg and ^{28}Si nuclei in the energy range from 23 to 28 MeV measured by Bobrowska et al. exhibit distinct maxima. It was shown that these maxima are not correlated with the structures seen in the excitation functions of the (α,α') and (α,p) reactions leading to low-lying excited states of the final nucleus possibly indicating the presence of Ericson fluctuations. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9799, 9822, 9823, 9824, 9825, 9830, 9934, 9940

9807 (ORO—4856-26, pp 456-457) **Systematics of alpha-particle strengths of low-lying levels in light sd-shell nuclei.** Anantaraman, N.; Draayer, J.P.; Gove, H.E. (Univ. of Rochester, NY). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A survey of alpha-particle spectroscopic factors of low-lying levels in sd-shell nuclei with A less than or equal to 29 as measured by the (^{6}Li,d) reaction at energies up to 36 MeV is presented. A comparison is made with theoretical predictions not only for inter- and intra-band transitions in a given nucleus, but also with the absolute ground state to ground state transitions. Substantial agreement is obtained, but some unexplained discrepancies remain. (auth)

9808 (ORO—4856-26, pp 528-529) **Evidence for a ^{12}C+^{12}C collective band in ^{24}Mg.** Cosman, E.R. (Massachusetts Inst. of Tech., Cambridge); Cormier, T.M.; Van Bibber, K.; Sperduto, A.; Young, G.; Erskine, J.; Greenwood, L.; Hansen, O. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Excitation functions of the ^{12}C(^{12}C,p)^{23}Na and ^{12}C(^{12}C,d)^{22}Na reactions are studied with high resolution from E/sub cm/(^{12}C) = 6.75 to 30 MeV using the BNL and ANL tandem Van de Graaff accelerators. The presence of a pronounced and correlated set of resonances near E/sub x/(^{24}Mg) = 25.2, 28.2, and 33.3 MeV appearing in the E/sub x/ = 9.04 and 9.81 MeV states of ^{23}Na is revealed. (auth)

9809 (ORO—4856-26, pp 534-535) **High spin states in ^{23}Na and the E/sub c.m./=19.3 MeV ^{12}C+^{12}C resonance.** Betts, R.R.; Back, B.B.; Gaarde, C.; Hansen, O.; Oeschler, H. (Niels Bohr Inst., Copenhagen). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9810 (ORO—4856-26, pp 536-537) **Neutron spectra from the ^{13}C(^{13}C,n)^{24}Mg reaction.** Kollarits, R.V.; Geller, K.N. (Drexel Univ., Philadelphia). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

In order to obtain additional information on the ^{12}C + ^{13}C system, the ^{12}C(^{13}C,n)^{24}Mg reaction is investigated which is more likely to evidence intermediate structure since the neutron is weakly bound to the ^{13}C core. Results on the neutron spectra from this reaction are presented. Back angle data are obtained by reversing the role of target and projectile. (auth)

9811 (ORO—4856-26, pp 538-539) **Intermediate structure in the ^{12}C(^{13}C,n)^{24}Mg reaction.** Geller, K.N.; Kollarits, R.V. (Drexel Univ., Philadelphia). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9812 **Low-lying states in ^{20}Ne populated by the ^{19}F(^{7}Li, ^{6}He)^{20}Ne reaction at 34 MeV.** Williams-Norton, M.E.; Hudson, G.M.; Kemper, K.W.; Moore, G.E.; Norton, G.A.; Puigh, R.J.; Zeller, A.F. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). *Phys. Rev., C;* 12: No. 6, 1899-1906(Dec 1975).

Angular distributions have been measured for transitions to ^{20}Ne states up to 7.43 MeV in excitation populated in the ^{19}F(^{7}Li, ^{6}He)^{20}Ne reaction at E_7 = 34 MeV. Elastic scattering of ^{6}Li and ^{7}Li at 34 MeV from ^{19}F was also performed and optical model parameters were determined from fits to the measured angular distributions. These optical model parameters were used in finite-range distorted-wave Born-approximation analyses of the single nucleon transfer data to extract spectrosopic factors for states at 0.0, 1.634, 4.247, 5.785, 6.722, and 7.424 MeV excitation in ^{20}Ne. Spectroscopic factors obtained from this reaction agree well with those from light-ion transfer reactions. However, the $2s_{1/2}$ calculation for the ^{20}Ne ground state is out phase with the data by 7 degree. The "j-forbidden" 4$^+$ state at 4.247 MeV excitation is found to be weakly excited in the ^{19}F(^{7}Li, ^{6}He)^{20}Ne reaction. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9621, 9774, 9778, 9779, 9781, 9782, 9783, 9795, 9811, 9844, 9846, 9847

9813 (BNL-NCS—50446, pp 14-33) **Evaluation of sodium-23 neutron capture cross section data for the ENDF/B V-III file.** Paik, N.C.; Pitterle, T.A. (Westinghouse Electric Corp., Madison, PA). Apr 1975.

In ENDF/B-IV dosimetry file.

The evaluation of neutron cross sections of ^{23}Na, material number 1156, for the ENDF/B File is described. Cross sections were evaluated between 10^{-5} eV and 15 MeV. Experimental data available up to March 1971 were included in the evaluation. (auth)

9814 (BNL-NCS—50446, pp 34-41) **Evaluation of the ^{32}S(n,p)^{32}P reaction for ENDF/B-III.** Dudley, N.D.; Kennerley, R. (Argonne National Lab., IL). Apr 1975.

In ENDF/B-IV dosimetry file.

The literature examined in this review includes all references in CINDA 71 and its supplements. Four experiments which have reported ^{32}S(n,p) cross sections near the reaction threshold of 1.6 MeV are compared. All used the activation technique and measured relative to a flux monitor. (auth)

9815 (ORO—4856-26, pp 238-239) **Anomalous large-angle α-scattering from ^{20}Ne.** Cowley, A.A.; Heymann, G.; Van Staden, J.C.; Burdzik, G.F.; Mills, S.J. (CSIR, Pretoria). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Backward-angle α-particle elastic scattering from ^{20}Ne is analyzed with a Regge pole model and compared with previous results for ^{16}O. (auth)

9816 (ORO—4856-26, pp 313-314) **Quasi-free (p,pα) scattering at 156 MeV on ^{24}Mg, ^{28}Si, ^{40}Ca and ^{58}Ni.** Bachelier, D.; Boyard, J.L.; Hennino, T.; Holmgren, H.D.; Jourdain, J.C.; Radvanyi, P.; Roos, P.G.; Roy-Stephan, M. (IPN, Orsay, France). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Differential cross-sections have been measured from 0 to 200 MeV/c recoil momentum and from 0 to 20 MeV excitation energy of the residual nuclei. The extraction of spectroscopic factors is under way. (auth)

9817 (ORO—4856-26, pp 325-326) **Evidence for surface α-particle clusters in Ag and Au from the (e,α) reaction.** Dodge, W.R.; Molen, H.V. (National Bureau of Standards, Washington, DC). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The (e,p) and (e,α) energy and angular distributions in Ag and Au were measured at several electron bombarding energies between 50 and 115 MeV. Taking the ratio of asymmetric to symmetric angular distribution yields as an estimate of the fractions of α-yields which cannot be accounted for by statistical theories in a

straight-forward manner, it is concluded that at electron bombarding energy of 110 MeV, 13 percent of our Ag and 14 percent of our Au α's cannot be accounted for by statistical processes. (auth)

9818 (ORO—4856-26, pp 354-355) **Gamma-ray production cross-sections from the interaction of 140 MeV alpha-particles with ^{27}Al (I).** Hornyak, W.F.; Chang, C.C.; Walters, W.B. (Univ. of Maryland, College Park). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9819 (ORO—4856-26, pp 356-357) **Gamma-ray production cross-sections from the interaction of 140 MeV alpha-particles with ^{27}Al (II).** Hornyak, W.F.; Wall, N.S. (Univ. of Maryland, College Park). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The pure evaporation model program was run for the ^{27}Al(α, 2α) and ^{27}Al(α, 3α) reactions to determine the yield. Limitations of the program are discussed. (BJG)

9820 (ORO—4856-26, pp 411-412) **Alpha-particle pick-up reactions in the 2sld shell.** Cossairt, J.D. (Indiana Univ., Bloomington); Bent, R.D.; Broad, A.S.; Becchetti, F.D.; Janecke, J. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The ^{24,26}Mg(d,^{6}Li)^{20,22}Ne, ^{28}Si(d,^{6}Li)^{24}Mg and ^{32}S(d,^{6}Li)^{28}Si reactions have been studied at E/sub d/ = 35 MeV. The results are in qualitative agreement with predictions of SU_3 theory. (auth)

9821 (ORO—4856-26, pp 315-316) **Quasifree scattering in the ^{24}Mg(p,pα)^{20}Ne reaction at 100 MeV.** Steinberg, R.I.; Chang, C.C.; Chant, N.S.; Didelez, J.P.; Holmgren, H.D.; Roos, P.G.; Wu, J.S. (Univ. of Maryland, College Park). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Quasifree scattering data are presented on the ^{24}Mg(p,pα) ^{20}Ne reaction for two pairs of quasifree angles for an incident proton energy of 100 MeV. (auth)

9822 Total yield measurements in ^{31}P(p,γ)^{32}S. Brien, R.O.; Switkowski, Z.E.; Smith, A.K.; Sargood, D.G. (Univ., Melbourne). *Aust. J. Phys.;* **28**: 155-162(1975).

The reaction ^{31}P(p,γ)^{32}S has been investigated in the proton energy range 0.33—1.75 MeV. Total γ-ray strengths were determined for 28 resonances. Yield curves were measured over limited portions of the energy range, which between them covered the whole range. An estimate of the nonresonant cross section was obtained, and total resonance widths were deduced. (auth)

9823 The ^{38}Ar(p,d)^{37}Ar reaction. Parker, P.D.; Howard, A.J. (Yale Univ., New Haven, Conn. (USA). Nuclear Structure Lab.); Goosman, D.R. (Brookhaven National Lab., Upton, N.Y. (USA)). *Nucl. Phys., A;* **250**: No. 2, 309-321(6 Oct 1975).

The ^{38}Ar(p,d)^{37}Ar reaction has been used to study the properties of the high-lying positive parity states in ^{37}Ar. Angular distributions in the region theta/sub cm/ = 16 to 132° have been analyzed using the DWBA code DWUCK to determine the spectroscopic properties of these states. The two lowest T = $^3/_2$ states have been identified at 4.98 MeV ($^3/_2^+$) and 6.65 MeV ($^1/_2^+$). The results are compared to recent shell-model calculations; their significance for the solar neutrino experiment is also discussed. (NL)

9824 Neutron capture cross section of natural silicon. Boldeman, J.W.; Allen, B.J.; Musgrove, A.R.deL. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). *Nucl. Phys., A;* **252**: No. 1, 62-76(3 Nov 1975).

The neutron capture cross section of natural silicon has been measured to 1500 keV by using the capture cross section facility of the 40-m station of the Oak Ridge Electron Linear Accelerator. Analysis of the present data, in combination with existing total cross section information, has provided almost complete resonance data for ^{28}Si. On the other hand, the capture kernel only (GAMMA/sub n/GAMMA/sub γ/GAMMA) has been obtained for neutron capture resonances in ^{29}Si and ^{30}Si. A strong positive correlation has been observed between the radiative width and the corresponding reduced neutron width for p-wave resonances in ^{29}Si, confirming significant valence effects. It is noted that a quantitative valence calculation provides only an approximate estimate of the valence strength for this nucleus. It was not possible to confirm, from the present measurements, reported asymmetry observed in two resonances in the ^{29}Si(γ,n) reaction. (NL)

9825 Neutron resonances in ^{24}Na via the (d, p) reaction. Blanpied, G.; Liljestrand, R.; Lynch, J.; McIntyre, J.; Ray, L.; Hoffmann, G.W. (Department of Physics, University of Texas, Austin, Texas 78712). *Phys. Rev., C;* **12**: No. 6, 1726-1729(Dec 1975).

Neutron resonances in ^{24}Na from E/subr/ = 0 to 1 MeV are studied with the ^{23}Na(d, p)^{24}Na reaction at E/subd/ = 11.0 MeV using a biased quadrupole spectrometer. Fractionated single-particle states are identified via their forward angle cross sections, using distorted wave Born-approximation predictions with resonance state form factors for the residual ^{24}Na system. Spectroscopic results are compared with those from (n, n) and/or (n, γ) studies over the same region of excitation. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9971

NUCLEAR REACTIONS AND SCATTERING

9826 Energy dependence of the surface absorption and Ni + ^{16}O scattering. Satchler, G.R. (Oak Ridge National Lab., Tenn. (USA)). *Phys. Lett., B;* **58**: No. 4, 408-410(29 Sep 1975).

Data for Ni + ^{16}O elastic scattering are analyzed to determine the real and imaginary potentials near the strong absorption radius as a function of bombarding energy. A strong energy dependence is found for the ratio of the imaginary part to the real part at this radius. (NL)

9827 Spin effects in the scattering of 1-GeV protons by nuclei. Kujawski, E.; Vary, J.P. (Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Phys. Rev., C;* **12**: No. 4, 1271-1277(Oct 1975).

The elastic scattering of 1-GeV protons by ^{58}Ni and ^{208}Pb is analyzed using the first-order optical potential including the spin-orbit term. These potentials are generated using realistic nucleon-nucleon scattering amplitudes and nuclear densities with full isospin dependence maintained. The sensitivity of the differential cross sections and polarizations to the spin-orbit potentials and nuclear densities is investigated.

9828 Folding-model analysis of elastic alpha—nucleus scattering. Singh, P.P.; Schwandt, P.; Yang, G.C. (Indiana Univ., Bloomington (USA)). *Phys. Lett., B;* **59**: No. 2, 113-117(27 Oct 1975).

A real potential obtained by folding the nucleon—nucleus phenomenological potential with the alpha-particle form factor is shown to describe elastic α-nucleus scattering data over a wide range of bombarding energy (20—160 MeV) and target mass (24—90 amu). The observed dependence of the α—nucleus potential strength on alpha energy is also well accounted for by the model. (NL)

9829 Two-step contributions to the ^{40}Ar(p,n)^{40}K anti-analog state transition. Rudolph, H.; Zafiratos, C.D.; Bentley, R.F.; Lind, D.A. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics); Rickertsen, L.D. (Oak Ridge National Lab., Tenn. (USA)). *Phys. Lett., B;* **59**: No. 2, 129-131(27 Oct 1975).

Calculations for the ^{40}Ar(p,n)^{40}K reaction to the 0$^+$ anti-analog state (AAS) are given along with experimental angular distributions for an incident proton energy of 22.8 MeV. The results of the calculations show little sensitivity to the parameters. The large-angle data and the relative strengths of the analog state and AAS cross sections indicate that the two-step (p,d)(d,n) process plays a dominant role in the AAS transition. (NL)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9833

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9848

9830 Systematics of ground-state α-particle spectroscopic strengths for sd- and fp-shell nuclei. Anantaraman, N.; Bennett, C.L.; Draayer, J.P.; Fulbright, H.W.; Gove, H.E.; Toke, J. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627). *Phys. Rev. Lett.*; **35**: No. 17, 1131-1134(27 Oct 1975).

We present systematics of the ground-state α-particle spectroscopic strengths for nuclei from ^{20}Ne to ^{66}Zn, measured in the (^{6}Li,d) reaction. An oscillatory decrease from ^{20}Ne to ^{32}S, which is in excellent agreement with SU(3) theory, is followed by a striking and unexplained increase at ^{36}Ar and ^{40}Ca and then a decrease up to ^{52}Ti, after which there is again a rise. (AIP)

9831 Level structure of ^{54}Mn from the ^{56}Fe(p,^{3}He) reaction at 40.2 MeV. Guichard, A.; Benenson, W.; Nann, H. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev., C;* **12**: No. 6, 1762-1770(Dec 1975).

The ^{56}Fe(p,^{3}He)^{54}Mn reaction has been studied at an incident energy of 40.2 MeV. Levels up to 6.16 MeV of excitation have been observed with an energy resolution of 25 keV. The experimental angular distributions have been analyzed with the distorted-wave Born approximation. Several L assignments have been made which, when compared to other experimental data, permitted new spin assignments. A comparison with theoretical calculations is also presented. (AIP)

9832 Lifetimes of some low-lying levels of ^{55}Co. Caldwell, S.E.; Alexander, L.A.; Arns, R.G.; Brunner, B.J.; Kovash, M.A.; Rozsa, C.M.; Smith, J.W. (The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., C;* **12**: No. 6, 2084-2087(Dec 1975).

Excitation energies and nuclear lifetimes of levels in ^{55}Co have been measured via the reaction ^{54}Fe(^{3}He, dγ)^{55}Co induced by 11.0 MeV incident ^{3}He^{++} particles. The Doppler shifted γ-ray spectra, taken in coincidence with the outgoing deuterons, were fitted by a line shape analysis program to determine the lifetimes. Experimental results for excitation energies (plus-or-minus 1 keV) and and lifetimes (ps) are: 2166, 0.141$^{+0.020}$/sub -//sub 0/./sub 0//sub 2//sub 1/; 2566, 0.620$^{+0.120}$/sub -//sub 0/./sub 0//sub 9//sub 0/; 2940, greater than or equal to 0.590; 3324, 0.090$^{+0.017}$/sub -//sub 0/./sub 0//sub 1//sub 2/; 4166, 0.050$^{+0.010}$/sub -//sub 0/./sub 0//sub 0//sub 5/. (AIP)

9833 Decay of ^{49}Cr. Jackson, S.V.; Henry, E.A.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* **12**: No. 6, 2094-2096(Dec 1975).

For the decay of ^{49}Cr the intensities of the 1361-, 1423-, 1508-, 1514-, and 1570-keV γ rays are found to be 0.85, 0.19, 0.15, 0.49, and 0.37, respectively, relative to I/sub gamma/ = 1000 for the 90-keV γ ray. Four other previously reported γ rays are shown to be sum peaks or contaminants. The recalculated β-decay branches and logft values (in parentheses) for ^{49}Cr decay are ground state (5.51), 90.639- (4.94), 152.928- (4.74), 1514.5- (5.71), 1661.1- (6.06), 2181.7- (7.0), 2236- (6.6), and 2310-keV (7.1). The known 3/2$^+$ level at 748 keV was not observed to be populated and a limit of logft > 9 was found for that level. (AIP)

9834 Further evidence for the recently discovered doublet in ^{49}Ca. Tape, J.W.; Ulrickson, M.; Benczer-Koller, N.; MacDonald, J.R. (Department of Physics, Rutgers University, New Brunswick, New Jersey 08903 and Bell Laboratories, Murray Hill, New Jersey 07974). *Phys. Rev., C;* **12**: No. 6, 2125-2126(Dec 1975).

The existence of a doublet near 4.51 MeV in ^{49}Ca is confirmed and the results of previous measurements are reexamined. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9631, 9738, 9774, 9778, 9779, 9781, 9782, 9783, 9795, 9816, 9831, 9832, 9834, 9876, 9883

9835 (BNL-NCS—50446) **ENDF/B-IV dosimetry file.** Magurno, B.A. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). Apr 1975. Contract E(30-1)-16. 285p. (ENDF—216; NEACRP-L—145; NEANDC(US)—193/L; INDC(US)—70/L). Dep. NTIS $8.75.

Separate abstracts have been prepared for 22 papers which appear in both Nuclear Science Abstracts and ERDA Research Abstracts. (SDF)

9836 (BNL-NCS—50446, pp 42-50) **Evaluation of the ^{45}Sc(n,γ)^{46}Sc reaction for ENDF/B-IV.** Magurno, B.A.; Mughabghab, S.F. Apr 1975.

In ENDF/B-IV dosimetry file.

Because of the importance of ^{45}Sc in dosimetry applications and its use as a filter to produce a "monoenergetic" neutron beam at 2.0 keV an accurate knowledge of the cross sections is required. A previous analysis and evaluation of the total cross section in the thermal and resonance region is extended here to include the capture cross section from the thermal region to 20 MeV. (auth)

9837 (BNL-NCS—50446, pp 51-69) **Evaluation of the (n,p) and (n,np) reactions of the isotopes of titanium for ENDF/B-IV.** Magurno, B.A. Apr 1975.

In ENDF/B-IV dosimetry file.

Threshold detectors generally use elemental titanium rather than isotopically enriched samples necessitating the evaluation of all the (n,p), (n,np), and (n,d) reactions of the major contributing isotopes separately. ^{49}Ti and ^{50}Ti are not dealt with here since they are both approximately 5 percent abundant and have small cross sections. The (n,np), (n,pn) and (n,d) reactions are lumped together and called (n,np). The energy range is divided into three regions. Region I is that of threshold to 7 MeV, Region II, 7 to 12 MeV and Region III, 12 to 20 MeV. (auth)

9838 (BNL-NCS—50446, pp 70-73) **Evaluation of the ^{55}Mn(n,2n)^{54}Mn cross section for ENDF/B-IV.** Magurno, B.A.; Takahashi, H. Apr 1975.

In ENDF/B-IV dosimetry file.

The ^{55}Mn(n,2n)^{54}Mn cross section was one of the reactions to be supplied by the Cross Section Evaluating Working Group (CSEWG) for the Interlaboratory LMFBR Reaction Rate Program (ILRR). This reaction was later incorporated into a complete isotopic evaluation for ENDF/B-IV by H. Takahashi. This description of the evaluation was extracted from the final report. (auth)

9839 (BNL-NCS—50446, pp 74-79) **Evaluation of the ^{54}Fe(n,p) Mn reaction for ENDF/B-III dosimetry file.** Schenter, R.E. (Hanford Engineering Development Lab., Richland, WA). Apr 1975.

In ENDF/B-IV dosimetry file.

The literature reviewed in this evaluation includes all references in CINDA 72 and its supplements plus papers describing recent measurements by Smith and Meadows and Paulsen and Widera. (auth)

9840 (BNL-NCS—50446, pp 80-87) **Evaluation of the ^{56}Fe(n,p)Mn cross sections for ENDF/B-III.** Dudey, N.D.; Kenneley, R. (Argonne National Lab., IL). Apr 1975.

In ENDF/B-IV dosimetry file.

The literature examined in this review includes all references in CINDA 71 and its supplements plus some very recent measurements near the reaction threshold. All reference cross sections have been renormalized to ENDF/B-III cross sections and weighted least-squared fitting routines were used to systematize the evaluations. (auth)

9841 (BNL-NCS—50446, pp 88-91) **Evaluation of the ^{56}Fe(n,γ)^{57}Fe reaction for ENDF/B-IV dosimetry file.** Schenter, R.E. (Hanford Engineering Development Lab., Richland, WA). Apr 1975.

In ENDF/B-IV dosimetry file.

The literature reviewed in this evaluation includes all references in CINDA 72 and its supplements plus the theoretical calculations of Green et al. (auth)

9842 (BNL-NCS—50446, pp 108-113) **^{58}Ni(n,2n)^{57}Ni reaction for ENDF/B-IV.** Bhat, M.R. Apr 1975.

In ENDF/B-IV dosimetry file.

An evaluation is made of the ^{58}Ni(n,2n)^{57}Ni cross section between threshold (12.415 MeV) and 20 MeV. (SDF)

9843 (BNL-NCS—50446, pp 114-119) **Evaluation of the ^{58}Ni(n,p)Co reaction for ENDF/-III dosimetry file.** Schenter, R.E. (Hanford Engineering Development Lab., Richland, WA). Apr 1975.

In ENDF/B-IV dosimetry file.

The literature reviewed in this evaluation includes all references in CINDA 72 and its supplements plus papers describing recent measurements by Smith and Meadows and Paulsen and Widera. (auth)

9844 (COO—2186-29) **Nuclear spectroscopy and nuclear reaction work with (A) the super Hilac at Berkeley; the heavy ion accelerator at Yale and (B) the 4 MeV Dynamitron SUNY, Albany, New York. Technical progress report, December 1, 1974—July 31, 1975.** Bakhru, H. (State Univ. of New York, Albany (USA)). 1975. Contract AT(11-1)-2186. 25p. Dep. NTIS $4.50.

Several projects initiated in the past year at the Heavy Ion Accelerator Laboratory have been brought to satisfactory conclusions and a number of new projects have been started. These new projects are logical extensions of our inquiries into nuclear structure through radioactive decay and in-beam spectroscopy. The collaboration efforts at Super-HILAC at Berkeley with Professor J. O.

Rasmussen and Professor N. Cue at SUNY/Albany have proved to be very effective and productive. The argon and krypton data from the Super-HILAC at Berkeley were analyzed to study x-rays in heavy ion collisions. Studies on millisecond isomer in ^{199m}Tl were completed. The measurements of the K-shell and L-shell ionization with fully stripped projectiles using various heavy ions have been carried out. The 4 MeV Dynamitron Accelerator at SUNY/Albany has been extensively used to conduct the high resolution studies of MeV heavy ion induced x-rays. Alpha capture studies on ^{35}Cl, ^{37}Cl and ^{31}P have been undertaken at SUNY/Albany. (auth)

9845 (ORO—4856-26, pp 160-161) **Possible connection between "ALAS" and anomalous (^{3}He,α) spectroscopic factors.** Apell, H.J. (Univ., Marburg, Ger.); Gemeinhardt, W.; Stock, R.; Betts, R.R.; Hansen, O.; Sperduto, A.; Fuchs, H.; Santo, R. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9846 (ORO—4856-26, pp 240-241) **Experimental study of nuclear structure effects in backward-angle alpha scattering.** Schiffer, J.P.; Eberhard, K.A.; Schiele, J.; Wit, M. (Univ., Munich). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The increase around A = 40 at backward angles in elastic α scattering is largely destroyed by a pair of nucleons in the f/sub $^7/_2$/ shell (^{40}Ar, ^{41}K, ^{42}Ca) but apparently not by one f/sub $^7/_2$/ particle (^{40}K) or one or a pair of d/sub $^3/_2$/ holes (^{39}K, ^{38}Ar). No similar effects appear in heavier nuclei. Recent studies of the energy dependence of this backward increase suggest that it is not due to an enhancement of compound elastic scattering, but to a direct (nonfluctuating) component. (auth)

9847 **Absolute cross sections for production of prompt nuclear γ rays by fast pions.** Jackson, H.E.; Kovar, D.G.; Meyer-Schutzmeister, L.; Vigdor, S.E.; Wangler, T.P.; Segel, R.E.; Schiffer, J.P.; Burman, R.L.; Gram, P.A.M.; Drake, D.M.; Lind, V.G.; Hatch, E.N.; Otteson, O.H.; McAdams, R.E.; Cook, B.C.; Clark, R.B. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.*; **35**: No. 17, 1170-1172(27 Oct 1975).

Cross sections have been measured for the production of prompt nuclear γ rays in the pion bombardment of Al, Ca, V, and ^{60}Ni. Several disagreements with values in the literature are noted. (AIP)

9848 **Vector analyzing power and cross section for (d(pol),p) reactions on ^{53}Cr, ^{57}Fe, ^{117}Sn, and ^{119}Sn.** Kocher, D.C.; Haeberli, W. (Wisconsin Univ., Madison (USA)). *Nucl. Phys., A;* **252**: No. 2, 381-415(10 Nov 1975).

Angular distributions of the vector analyzing power and the absolute cross section were measured for (d(pol),p) reactions on the odd-A nuclei ^{53}Cr and ^{57}Fe at a deuteron energy of 10 MeV and on ^{117}Sn and ^{119}Sn at 12 MeV. It is shown that the separate cross section contributions for the different allowed total angular momenta j/sub n/ of the captured neutron can be determined from the measurements. For transitions which are dominated by a single value of j/sub n/, the measurements are compared with distorted-wave Born-approximation calculations. The energies of the 2p/sub 3/2/ and 2p/sub 1/2/ neutron single-particle states in ^{54}Cr and ^{58}Fe were determined, and the strength of the nuclear spin—orbit interaction was calculated. The vector analyzing power and the cross section were also measured for deuteron elastic scattering from each target nucleus in order to determine optical-model parameters for the DWBA calculations. (NL)

9849 **Effective cross sections for the (n, 2pn), (n, 3p), and (n, 3pn) reactions using intermediate-energy neutrons.** Hill, J.C.; Shirk, D.G.; Petry, R.F.; Wang, K.H. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). *Phys. Rev., C;* **12**: No. 6, 1978-1982(Dec 1975).

"Effective cross sections" for the (n, 2pn), (n, 2p), and (n, 3pn) reactions on various targets were measured relative to the ^{12}C(n, 2n)^{11}C reaction. The bombarding particles were the spectrum of neutrons generated in a Cu beamstop by 750-MeV protons. The cross section systematics as a function of target mass number are compared with available 14-MeV neutron cross sections for (n,^{3}He) and (n,2p) reactions and with results from intranuclear-cascade calculations. (AIP)

9850 **^{51}V(d, n_0)^{52}Cr reaction with polarized deuterons.** Quin, P.A.; Thomson, J.A. (University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev., C;* **12**: No. 6, 2118-2120(Dec 1975).

The vector analyzing power of the ^{51}V(d, n_0)^{52}Cr reaction has been measured for laboratory angles between 5 degree and 40 degree at a deuteron energy of 11 MeV. Distorted-wave calculations are in qualitative agreement with the observed angular dependence of the vector analyzing power. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9852

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9830, 9861

9851 **Neutron-induced gamma-ray production in zinc for incident-neutron energies of 4.9, 5.4, and 5.9 MeV.** Dickens, J.K. (Oak Ridge National Lab., TN). *Nucl. Sci. Eng.;* **58**: No. 3, 331-338(Nov 1975).

Interactions of neutrons with zinc have been studied by measuring gamma-ray-production cross sections. For a sample of natural zinc, spectra were obtained for incident-mean-neutron energies, E/sub n/ = 4.9, 5.4, and 5.9 MeV with gamma-ray detector systems utilizing coaxial Ge(Li) detectors. Nearly monoenergetic neutrons were obtained from the D(d,n) reaction using deuterons obtained from the (pulsed) Oak Ridge National Laboratory 5-MV Van de Graaff accelerator. Time-of-flight was used to discriminate against pulses due to neutrons and background radiation. Gamma-ray identification was aided by obtaining spectra for samples enriched in the isotopes ^{64}Zn and ^{68}Zn, and new information on the level structure of ^{64}Zn is reported. These cross sections have been compared, where possible, with previous comparable measurements with generally satisfactory results. 2 figures, 3 tables. (auth)

9852 **Directional correlations of gamma rays in ^{77}As.** Cherry, R.N. Jr.; Wiedenbeck, M.L. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). *Nucl. Phys., A;* **252**: No. 2, 445-451(10 Nov 1975).

Directional correlation measurements have been made for γ transitions in ^{77}As following the decay of 11.30-h ^{77}Ge by using two Ge(Li) detectors. By using the method of Chow et al., mixing ratios of γ transitions and the spins of seven levels have been deduced with only a ground-state spin of $^3/_2$ being assumed. Levels for which spins were deduced are 216($^3/_2$), 264($^5/_2$), 475($^9/_2$), 632($^5/_2$), 1189($^7/_2$), 1458($^3/_2$) and 1582($^5/_2$) keV. (NL)

9853 **Excited analogs in ^{62}Ni and ^{63}Cu(p, n) and the weak-coupling model.** Wong, C.; Anderson, J.D.; Brown, V.R.; Davis, J.C.; Grimes, S.M.; Madsen, V.A.; Poppe, C.H. *Phys. Rev., C;* **12**: No. 6, 2115-2117(Dec 1975).

The ground- and 2^+ excited-state analog cross sections in ^{62}Ni(p, n) have been measured at bombarding energies of 16, 19, and 22 MeV. The measurements at 19 and 22 MeV confirm the weak coupling and Thankappan-True prediction of ~ 0.4 for the fractionation of the 2^+ strength into the $7/2^-$ excited analog transition in ^{63}Cu(p, n). At 16 MeV, agreement with the weak-coupling model is poor. The discrepancy is possibly due to a preequilibrium contribution to the $7/2^-$ excited analog transition in ^{63}Cu(p, n). (AIP)

9854 **Level structure of ^{60}Co.** Jolivette, P.L.; Goss, J.D.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). *Phys. Rev., C;* **12**: No. 6, 2121-2124(Dec 1975).

Level energies of ^{60}Co were measured using the ^{59}Co(d,p)^{60}Co reaction and the 100 cm broad range magnetic spectrograph. In order to excite nearly all states the data were taken at θ/sub lab/ greater than or equal to 60degree. Energies for 89 states having E/subx/ less than or equal to 3.2 MeV were measured with uncertainties of 1 keV or less. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9621, 9774, 9779, 9781, 9835, 9847, 9849, 9851, 9853, 9854

9855 (BNL-NCS—50446, pp 92-107) **Evaluation of ^{59}Co(n,γ)^{60}Co, ^{59}Co(n,2n)^{58}Co, ^{59}Co(nα)^{56}Mn, for ENDF/B-IV.** Krieger, T.J. (Argonne National Lab., IL); Smith, A.B.; Smith, D.L.; Jenkins, J.D. Apr 1975.

In ENDF/B-IV dosimetry file.

The present evaluation of ^{59}Co (n,γ) for ENDF/B IV consists of two parts, an evaluation below 100 keV by T. J. Krieger, Brookhaven National Laboratory, and one above 100 keV by A. B. Smith and D. L. Smith, Argonne National Laboratory. (auth)

9856 (BNL-NCS—50446, pp 120-125) **^{60}Ni(n,p)^{60}Co reaction for ENDF/B-IV.** Bhat, M.R. Apr 1975.

In ENDF/B-IV dosimetry file.

The ^{60}Ni(n,p)^{60}Co cross section is evaluated in the energy range 5.76 to 19.55 MeV. (SDF)

9857 (BNL-NCS—50446, pp 126-142) **^{63}Cu(n,γ); (n,α) reactions for ENDF/B-IV.** Alter, H. Apr 1975.

In ENDF/B-IV dosimetry file.

Evaluated data sets for ^{63}Cu(n,γ) and (n,α) reactions contained in the ENDF/B-III and SAND files were reviewed, compared and where possible, intercompared with measured data. (auth)

9858 (BNL-NCS—50446, pp 143-149) **^{63}Cu(n,2n)^{64}Cu reaction for ENDF/B-IV.** Rose, P.F. Apr 1975.

In ENDF/B-IV dosimetry file.

The ^{63}Cu(n,2n)^{64}Cu reaction has been re-evaluated for the ENDF/B-files using a combination of selected experimental data and a semi-empirical technique for fitting the data at energies above 15 MeV. An estimate of the (n,3n) reaction was also obtained as a result of the analysis. (auth)

9859 (ORO—4856-26, pp 350-351) **Preequilbrium alpha emission from proton, deuteron, ^{3}He and alpha induced reactions: evidence for alpha preformation in nuclei.** Chevarier, A.; Chevarier, N.; Demeyer, A. (Univ., Lyon). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Measurements of continuous energy spectra and angular distributions of alpha particles emitted in proton, deuteron, ^{3}He and alpha induced reactions were performed. An analysis using the preequilibrium model succeeds in giving an overall description of particle spectra. The alpha particle in this approach being considered as an exciton, a preformation factor around 0.2 for four nucleons to be correlated as an alpha particle is found. The alpha preformation probability deduced from this analysis is independent of the proton, deuteron ^{3}He incident channel and target nucleus mass. (auth)

9860 Observation of Wigner cusps in the ^{64}Ni(p,γ)^{65}Cu reaction. Mann, F.M.; Dayras, R.A.; Switkowski, Z.E. (California Inst. of Tech., Pasadena (USA)). *Phys. Lett., B;* **58**: No. 4, 420-422(29 Sep 1975).

Gamma-ray yield measurements are reported for the ^{64}Ni(p,γ)B65Cu reaction over an energy range which includes several low-lying (p,n) thresholds. A strong decrease in the (p,γ) yield at the opening of the neutron channels is interpreted as a superposition of several Wigner cusps. Statistical model calculations successfully reproduce the observations. (NL)

9861 ^{90}Zr and ^{92}Zr: Neutron total and scattering cross sections. Guenther, P.; Smith, A.; Whalen, J. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **12**: No. 6, 1797-1808(Dec 1975).

Total neutron cross sections of ^{90}Zr and ^{92}Zr were measured from 0.9 to 5.5 MeV and elastic and inelastic neutron scattering cross sections from 1.8 to 4.0 MeV. The inelastic neutron excitations of six states in ^{90}Zr and more than 12 in ^{92}Zr were observed. The experimental results formed the basis of an optical-statistical model interpretation including considerations of resonance width fluctuation and interference and the behavior of the optical potential near N = 50. Comparisons of measured and calculated cross sections suggested new spin assignments for a number of excited states. (AIP)

9862 (d, p) reactions in the continuum. Chan, K.C.; Cohen, B.L.; Shabason, L.; Alzona, J.E.; Congedo, T. (University of Pittsburgh, Nuclear Physics Laboratory, Pittsburgh, Pennsylvania 15260). *Phys. Rev., C;* **12**: No. 6, 1844-1849(Dec 1975).

^{63}Cu,^{116}Cd(d, p) reaction cross sections in the continuum regions have been measured for deuteron energies 9, 10.5, and 12 MeV. They are compared to a theoretical calculation in which the spectroscopic factors of usual (d, p) reaction calculations for nuclear states are replaced by the strength distributions for different single neutron configurations. These distributions are Gaussian curves centered at single neutron orbits with widths proportional to their excitation energies. Good agreement is found for angular distributions and incident deuteron energy dependences, although the predicted absolute cross sections are about 50% higher than the measurements. Uncertainties in the calculations are discussed. (AIP)

9863 Polarization measurements and optical-model potential for tritons. Hardekopf, R.A.; Veeser, L.R.; Keaton, P.W. Jr. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **35**: No. 24, 1623-1625(15 Dec 1975).

The recent installation of a polarized-triton-ion source on the Los Alamos Scientific Laboratory tandem Van de Graaff accelerator has allowed the measurement of analyzing powers for triton elastic scattering over a wide range of angles. The data obtained from scattering polarized tritons on ^{52}Cr, ^{60}Ni, ^{90}Zr, and ^{208}Pb show unexpectedly large analyzing powers at backward angles. This leads to spin-orbit well depths greater than predicted by an optical-model analysis based on folding-model calculations. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 9945

ENERGY LEVELS AND TRANSITIONS

9864 (ORO—1316-198) **Nuclear structure at intermediate energies. Progress report, April 1, 1975—March 31, 1976.** Phillips, G:C. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). 1975. Contract E(40-1)-1316. 28p. Dep. NTIS $4.00.

Experimental research on nuclear structure from the study of strong interactions at intermediate energies is summarized. A list of publications is included. (JFP)

MOMENTS AND SPIN

9865 Determination of the sign and magnitude of the nuclear quadrupole interaction by β-γ directional correlations. Raghavan, R.S.; Raghavan, P.; Kaufmann, E.N. (Bell Laboratories, Murray Hill, New Jersey 07974). *Phys. Rev., C;* **12**: No. 6, 2022-2032(Dec 1975).

Experiments are reported which demonstrate that the sign and magnitude of the quadrupole interaction of excited nuclear states can be reliably determined by means of time-differential β-γ directional correlations with radioactive sources embedded in noncubic single crystals. The 828 keV level of ^{115}In and the 247 keV level of ^{111}Cd, fed by an allowed and a unique first-forbidden β decay, respectively, have been investigated by this method. The coupling constants e^2qQ of these levels in Cd metal at 298 degree K are: -146(5) MHz for ^{115}In and +125(4) MHz for ^{111}Cd. The positive coupling constant for ^{111}Cd in Cd coupled with a positive quadrupole moment Q of this level implies a positive electric field gradient in Cd confirming recent theoretical predictions. The negative e^2qQ for the ^{115}In level in Cd metal correspondingly indicates a negative Q for this level in conformity with its description as a member of a K = 1/2 rotational band. The paper includes a discussion of the major concepts underlying the various methods available now for determination of the sign of e^2qQ. Also, a detailed account of theoretical formulas necessary to evaluate allowed and forbidden β-γ perturbed angular correlations and a brief discussion of the significance of the technique for further studies of nuclear quadrupole effects in materials are given. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9828

9866 (ORO—4856-26, pp 234-235) **Is the form factor of the alpha particle optical potential energy dependent.** Budzanowski, A.; Grotowski, K.; Strzalkowski, A. (Jagellonian Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 9969

9867 (ORO—4856-26, pp 589-590) **Binary and ternary fission of superheavy nuclei.** Schultheis, H.; Schultheis, R. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Calculated ternary fission barriers of superheavy nuclei are found to exceed the binary barriers by only 10—35 percent. The importance for the discovery of superheavy nuclei is discussed. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9572, 9869, 9872, 9893

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9848, 9865, 9880

9868 (ORO—3346-173) **Nuclear and x-ray spectroscopy with radioactive sources. Eleventh annual progress report, February 1, 1975—January 31, 1976.** Fink, R.W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). 31 Oct 1975. Contract AT(40-1)-3346. 38p. Dep. NTIS $5.00.

Separate abstracts have been prepared for five sections of the report. (SDF)

9869 **Directional correlations of γ-rays in ^{143}Pr.** Cherry R.N. Jr.; Wiedenbeck, M.L. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). *Nucl. Phys., A;* **252**: No. 2, 437-444(10 Nov 1975).

Directional correlation measurements have been made for γ transitions in ^{143}Pr following the decay of 33.0-h ^{143}Ce by using two Ge(Li) detectors. Correlation coefficients are reported for twelve cascades, of which coefficients for five cascades are previously unreported. Deduced are mixing ratios for thirteen transitions and spins and parities for the following levels: 57 $^{5}/_{2}^{+}$, 351 $^{3}/_{2}^{+}$, 490 $^{5}/_{2}^{+}$, 722 $^{3}/_{2}^{+}$, 739 $^{1}/_{2}^{-}$, 938 $^{3}/_{2}^{+}$, and 1160 $^{3}/_{2}^{+}$ keV. (NL)

9870 **Band structure in $^{131\ 132\ 133}$Ba observed by (^{12}C,xn) reactions.** Gizon, J.; Gizon, A.; Horen, D.J. (Grenoble-I Univ., 38 (France). Inst. des Sciences Nucleaires). *Nucl. Phys., A;* **252**: No. 2, 509-523(10 Nov 1975).

High-spin levels in Ba isotopes are observed in the reactions $^{122\ 124}$Sn(^{12}C,3nγ)$^{131\ 133}$Ba and ^{124}Sn(^{12}C,4nγ)^{132}Ba. They are studied by in-beam spectroscopic methods such as prompt and delayed spectra, excitation functions, γ—γ coincidences and angular distributions. Bands are found on the $^{11}/_{2}^{-}$ isomeric state in ^{133}Ba and on the $^{9}/_{2}^{-}$ isomeric state in ^{131}Ba which are in agreement with the structure of other nuclei with 77 and 75 neutrons and with prolate deformation. A negative-parity band with both even- and odd-spin members from 5^{-} to 9^{-} is found in ^{132}Ba. (NL)

9871 **Neutron hole states of ^{99}Mo.** Bindal, P.K.; Youngblood, D.H.; Kozub, R.L.; Hoffmann-Pinther, P.H. (Cyclotron Institute and Physics Department, Texas AandM University, College Station, Texas 77843). *Phys. Rev., C;* **12**: No. 6, 1826-1833(Dec 1975).

The (p, d) and (d, t) reaction on ^{100}Mo have been used at bombarding energies of ~ 40 MeV to populate neutron hole states of ^{99}Mo. Excitation energies and angular distributions were measured for levels up to 4.25 MeV in excitation. A distorted wave Born approximation analysis was used to make l assignments and to obtain spectroscopic factors. Three distinct groups of weakly excited levels, one corresponding to l = 4 and two corresponding to l = 1, were observed lying above 2.15 MeV excitation. A hole-core-coupling model is used to predict the properties of ^{99}Mo and fair agreement with the experiment is obtained. (AIP)

9872 **Two-particle, one-hole states in antimony nuclei and the decay of ^{121}Te/supm/, /supg.** Meyer, R.A.; Lanier, R.G.; Larsen, J.T. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* **12**: No. 6, 2010-2012(Dec 1975).

The decay of ^{121}Te/supm/,/supg/ and the concomitant γ rays from levels of ^{121}Sb have been measured. The decay of ^{121}Te/subg/ is found to populate levels at (J/sup pi//logft value given in parentheses) 507.59 keV (3/2^{+}/6.87) and 573.14 keV (1/2^{+}/6.11), while the decay of ^{121}Te/subm/ is found to populate levels at g.s. (5/2^{+}/:), 37.138 keV (7/2^{+}/logf$_{t}$t = 9.63), 946.99 keV (9/2^{+}/9.93), 1024 keV (7/2^{+}/logf$_{t}$t greater than or equal to 12.35), 1035.53 keV (9/2^{+}/9.70), 1139.29 keV (11/2^{+}/7.85), and 1144.65 keV (9/2^{+}/11.19). These levels and their decay properties are found to be described well by recent calculations which include two-particle, one-hole configurations (2p-1h). Decay of the 2p-1h 1/2^{-} and 3/2^{-} levels in ^{119}Sb populated in the decay of ^{119}Te are also presented. (AIP)

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 9865

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9779, 9781, 9782, 9835, 9848, 9849, 9862, 9863, 9870, 9871

9873 (BNL-NCS—50446, pp 150-157) **^{115}In(n,n')/sup 115m/In reaction for ENDF/B-III.** Sher, R. (Stanford Univ., CA). Apr 1975.

In ENDF/B-IV dosimetry file.

An analysis is made of the energy dependence of the cross section for excitation of the 4.5 hour, 335 keV isomeric state in ^{115}In by neutron inelastic scattering. (SDF)

9874 (BNL-NCS—50446, pp 158-166) **Evaluation of ^{115}In(n,γ ^{1}h for ENDF/B-IV.** Schmittroth, F. (Hanford Engineering Development Lab., Richland, WA). Apr 1975.

In ENDF/B-IV dosimetry file.

An evaluation has been made of the ^{115}In(n,γ)/sup 116m/In reaction, emphasizing resolved resonance parameters and smooth capture cross sections. Both the 54.2 minute state at 0.126 MeV and the 2.2 second state at 0.289 MeV are included. (SDF)

9875 (BNL-NCS—50446, pp 167-173) **^{127}I(n,2n)^{126}I cross-section for ENDF/B-IV.** Sher, R. (Stanford Univ., CA). Apr 1975.

In ENDF/B-IV dosimetry file.

An evaluation is made of the ^{127}I(n,2n)^{126}I cross section from threshold to about 18 MeV. (SDF)

9876 (COO—2696-001) **Determination of neutron capture cross sections and resonance parameters for vanadium and the isotopes of tellurium. Progress report, June 1, 1975—November 30, 1975.** Winters, R.R. (Denison Univ., Granville, Ohio (USA)). Dec 1975. Contract E(11-1)-2696. 5p. Dep. NTIS $3.50.

Analysis of ^{51}V(n,γ) data taken at the forty-meter flight station at the Oak Ridge Electron Accelerator has been essentially completed over the neutron energy (laboratory) range 2.5-100 keV. Resonance parameters for some seventy-five resonances have been extracted. In particular, radiative widths not previously measured have been obtained for many resonances above 50 keV. Data analysis will be continued at least up to neutron energy 150 keV. As part of our continuing study of mass-dependent behavior of resonance parameters, a continuing interest in the astrophysical applications of (n,γ) cross sections, and as a test of recent modifications to our analysis computer codes, data analysis (begun before the initiation of this contract) of ^{203}Tl (n,γ) and ^{205}Tl (n,x) data was continued. This work is now essentially completed over the neutron energy range 2.5-100 keV. Departures from predictions of the statistical model for the resonance parameters have been observed. After considerable effort, it has been concluded that the Denison computer system is not adequate for certain aspects of the required data analysis. Alternate approaches to enable data analysis to be done during the academic year at Denison are being considered. The analysis of the Te(n,γ) data is barely under way and will be the primary focus of efforts over the coming year. However, the tellurium (n,γ) data (for mass numbers 122, 124, 125, 126, 128 and 130) have been processed from the time-of-flight form to effective cross section and a normalization to a recent natural tellurium (n,γ) measurement has been completed. (auth)

9877 (ORO—4856-26, pp 409-410) **Alpha-cluster pickup reactions on rare-earth nuclei.** Milder, F.L.; Janecke, J.; Becchetti, F.D. (Univ. of Michigan, Ann Arbor). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Systematics of the (d,^{6}Li) reaction on rare-earth nuclei have been studied at E/sub d/ = 35 MeV. Alpha-particle correlations appear to be important for these nuclei. (auth)

9878 (ORO—4856-26, pp 417-418) **Neutron blocking in the (d,^{6}Li) alpha-particle transfer reaction.** Becchetti, F.D.; Chua, L.; Janecke, J. (Univ. of Michigan, Ann Arbor). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The (d,^{6}Li) α-transfer reaction has been studied on even-A and odd-A tin isotopes at E/sub d/ = 35 MeV. The odd-A isotopes exhibit large blocking effects (approximately factor two) similar to those observed in (p,t) reactions. (auth)

9879 (ORO—4856-26, pp 599-600) **Elastic scattering of heavy-ions from even isotopes of tin.** Durell, J.L.; Christy, A.; Grant, I.S. (Univ. of Manchester, Eng.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Heavy ions of different nuclear structure have been elastically scattered from the even isotopes of tin. The projectiles used are the closed shell nucleus ^{40}Ca and the neutron rich isobar ^{40}Ar; the deformed nucleus ^{20}Ne; and the higher z, fp-shell nuclei ^{56}Fe and ^{63}Cu. (auth)

9880 **Neutron resonance capture in ^{138}Ba.** Musgrove, A.R.deL.; Allen, B.J.; Bolderman, J.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights); Macklin, R.L. (Oak Ridge National Lab., Tenn. (USA)). *Nucl. Phys., A;* **252**: No. 2, 301-314(10 Nov 1975).

The neutron capture cross section of ^{138}Ba has been measured with high resolution to 100 keV, and resonance parameters have been extracted. A number of new levels are observed. The s-wave radiative width is found to be six times the p-wave radiative width, and is also considerably larger than for other nuclei in this mass region. Valence capture and enhanced decay to single-particle final states could account for the large s-wave radiative strength. A large positive correlation between GAMMA/sub n/^{0} and GAMMA/sub γ/ for ten s-wave levels was found (rho = 0.67). The following average resonance parameters were deduced: [D] = 7.5 +- 1.5 keV, $S_0 = (0.9 +- 0.4) \times 10^{-4}$, S_1 approximately equal to 0.5×10^{-4}; |GAMMA/sub γ/|/sub s/ = 310 +- 25 MeV and |GAMMA/sub γ/|/sub p/ = 47 +- 5 MeV. Evidence for a predominant direct capture mechanism for thermal capture is presented. (NL)

9881 **Activation cross sections for reactions of ^{109}Ag induced with ^{40}Ar ions.** Hille, M. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.); Hille, P. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Radiumforschung und Kernphysik); Gutbrod, H.H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)); Blann, M. (Rochester Univ., N.Y. (USA). Dept. of Chemistry). *Nucl. Phys., A;* **252**: No. 2, 496-508(10 Nov 1975).

Activation cross sections for reactions of enriched targets of ^{109}Ag with ^{40}Ar ions of 288 and 228 MeV have been determined by γ-ray spectroscopy. Yields of evaporation residues and low-mass transfer products have been measured. Evaporation residue yield-mass distributions are compared with three sets of statistical model results. The calculation based on a rotating liquid drop model with fission competition is in very good agreement with experimental results. It is shown that the yields are inconsistent with a mechanism of incomplete fusion plus evaporation. (NL)

9882 **Effects of the triton D state in (d, t) reactions.** Knutson, L.D.; Hichwa, B.P.; Barroso, A.; Eiro, A.M.; Santos, F.D.; Johnson, R.C. (University of Washington, Seattle, Washington 98195). *Phys. Rev. Lett.;* **35**: No. 23, 1570-1573(8 Dec 1975).

Measurements of the tensor analyzing powers for (d,t) reactions on ^{118}Sn and ^{208}Pb are presented. It is shown that the measured quantities are sensitive to the D-state components in the triton wave function. The magnitudes of the observed analyzing powers are in good agreement with predictions obtained from a triton D-state wave function calculated in first-order perturbation theory. (AIP)

9883 **Observation of giant Gamow—Teller strength in (p,n) reactions.** Doering, R.R.; Galonsky, A.; Patterson, D.M.; Bertsch, G.F. (Cyclotron Laboratory, Department of Physics, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev. Lett.;* **35**: No. 25, 1691-1693(22 Dec 1975).

In ^{90}Zr(p,n)^{90}Nb spectra for E/subp/=35 and 45 MeV, a strong enhancement of the T=4 continuum is observed over a range of excitation energies (full width at half-maximum of 4.2plus-or-minus0.4 MeV) centered at 8.4plus-or-minus0.3 MeV. The data are consistent with an interpretation of the broad peak as a $(\pi g_{9/2}, \nu g_{9/2}^{-1})_1$/sub +/ excitation which corresponds to the giant magnetic-dipole resonance. Similar structure is observed near the isobaric analog state of ^{48}Ca, ^{120}Sn, and ^{208}Pb. (AIP)

9884 **Search for fragment emission from nuclear shock waves.** Poskanzer, A.M.; Sextro, R.G.; Zebelman, A.M.; Gutbrod, H.H.; Sandoval, A.; Stock, R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **35**: No. 25, 1701-1704(22 Dec 1975).

Energy spectra and angular distributions have been measured of ^{3}He and ^{4}He fragments emitted from Ag and U targets, bombarded with 2.7-GeV protons, and 1.05-GeV/nucleon α particles and ^{16}O ions. All cross sections increase dramatically with projectile mass. No narrow peaks are found in the angular distributions or in the energy spectra. (AIP)

9885 **Neutron capture cross section of niobium-93 from 2.6 to 700 keV.** Macklin, R.L. (Oak Ridge National Lab., TN). *Nucl. Sci. Eng.;* **59**: No. 1, 12-20(Jan 1976).

The neutron capture cross section of stable ^{93}Nb was measured by time-of-flight methodology at the Oak Ridge Linear Electron Accelerator. Individual resonances were parameterized to 7.4 keV with energy resolution less than or equal to 0.14 percent full-width-at-half-maximum. The average cross section was deduced from 3 to 700 keV with an accuracy estimated at 3 to 5 percent SD. The average data to 100 keV are well fitted by strength functions, but the fluctuations about the fit are not consistent with an energy-dependent level density proportional to 2J + 1 beyond 20 keV. 3 figures, 2 tables (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9943

9886 (ORO—3346-173, pp 3-9) **Nuclear systematics.** 31 Oct 1975.

In Nuclear and x-ray spectroscopy with radioactive sources. Eleventh annual progress report, February 1, 1975—January 31, 1976.

Research progress in nuclear systematics of odd mass nuclei and coupling of an odd nucleon to the core, low energy structure of even-even nuclides, odd-A nuclei and coupling schemes are presented. (SDF)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 9867

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9572

9887 **Some decay properties of ^{183}Ir.** Ladenbauer-Bellis, I.M. (Yale Univ., New Haven, Conn. (USA). Heavy Ion Accelerator Lab.); Bakhru, H.; Sen, P. (State Univ. of New York, Albany (USA)). *Nucl. Phys., A;* **252**: No. 2, 524-532(10 Nov 1975).

The isotope ^{183}Ir was produced at the Yale Heavy Ion Accelerator via the ^{175}Lu(^{12}C,4n)^{183}Ir reaction and from the decay of ^{183}Pt, which was formed in the ^{169}Tm(^{19}F,5n)^{183}Pt reaction. The half-life of ^{183}Ir was found to be 55 + - 5 min. Singles and coincidence γ-ray measurements were performed using 30-40 cm^3 Ge(Li) detectors. X-ray measurements were carried out using an intrinsic Ge detector. The following γ-rays were found to belong to the decay of ^{183}Ir:30.8, 87.7, 96.2, 102.2, 107.7, 136.8, 165.7, 194.5, 228.5, 236.7, 250.6, 254.4, 282.4, 286.1, 296.3, 314.4, 319.1, 342.2, 347.7, 392.4, 411.2, 457.7, 461.9, 498.4, 617.4, 655.1, 670.8, 692.2, 706.1, 724.8, 800.1 and 896.7 keV. A tentative decay scheme for ^{183}Ir is proposed verifying levels in ^{183}Os. (NL)

9888 **Gamma-ray angular distributions and parity tests in the decays of polarized ^{173}Lu and ^{174}Lu/supm/,/supg/.** Krane, K.S.; Olsen, C.E.; Rosenblum, S.S.; Steyert, W.A. (Department of Physics, Oregon State University, Corvallis, Oregon 97331). *Phys. Rev., C;* **12**: No. 6, 1999-2009(Dec 1975).

Angular distributions of 18 γ-rays have been measured following the decays of ^{173}Lu and ^{174}Lu/supm/,/supg/ polarized at low temperatures in the ferromagnetic cubic Laves-phase metal $ZrFe_2$. The magnetic moments of the oriented parent states are deduced to be vertical-bar μ (^{173}Lu) vertical-bar = (2.34 plus-or-minus 0.09) μ/subN/, vertical-bar μ (^{174}Lu/supg/) vertical-bar = (1.94 plus-or-minus 0.28) μ/subN/, and vertical-bar μ (^{174}Lu/supm/) vertical-bar = (2.34 plus-or-minus 0.33) μ/subN/. The spin of the 1518-keV level of ^{174}Yb is shown unambiguously to be 6. Multipole mixing ratios are deduced for a number of ^{173}Yb and ^{174}Yb γ-rays, and several interband E2/M1 mixing ratios are compared with values deduced from a Coriolis mixing calculation. The 0 degree —180 degree asymmetries of the angular distributions of some of the strongly hindered ^{174}Yb transitions have been observed in a search for the presence of parity mixing effects; no such effects were seen. A possible empirical correlation between γ-ray

hindrance and the magnitude of parity-violating effects is pointed out. (AIP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9887, 9888

9889 **Level structure of ^{172}Yb from the ^{171}Yb(n,γ) reaction.** Greenwood, R.C.; Reich, C.W. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)); Vegors, S.H. Jr. (Idaho State Univ., Pocatello (USA)). *Nucl. Phys., A;* **252**: No. 2, 260-292(10 Nov 1975).

The energy-level structure of the nucleus ^{172}Yb has been studied using the ^{171}Yb(n,γ) reaction with both thermal and 2-keV neutrons. Gamma-ray energy and intensity measurements were made using Ge(Li) detectors. From these data, a neutron separation energy of 8020, 1 +- 0.5 keV has been determined for ^{172}Yb. In addition, a level scheme is proposed for ^{172}Yb. Where possible, these states have been grouped into rotational bands. A total of fourteen such rotational bands with band-head energies below 2.2 MeV are contained in the proposed level scheme. Because of the averaging feature of the 2 keV neutron-capture data, it is believed that all the positive-parity states with I = 0, 1 and 2 with energies below 2.3 MeV in ^{172}Yb have been identified in this study. (NL)

9890 **Residual interactions in four-quasiparticle K/sup pi/=14$^-$ isomer in ^{176}Hf.** Khoo, T.L.; Bernthal, F.M.; Warner, R.A.; Bertsch, G.F.; Hamilton, G. (Cyclotron Laboratory and Departments of Physics and Chemistry, Michigan State University, East Lansin, Michigan 48824). *Phys. Rev. Lett.;* **35**: No. 19, 1256-1259(10 Nov 1975).

For the first time, a four-quasiparticle isomer has been located and identified in a deformed nucleus. Its energy may be used as a test for the effective interaction between quasiparticles. A simple δ-function interaction can account for the energy quite well, but not an interaction derived from Brueckner theory. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9782, 9877, 9889

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9967

9891 **Calculations of electron energy distributions for internal ionization during the alpha decay of ^{210}Po employing the binary-encounter approximation.** Watson, R.L. (Department of Chemistry and Cyclotron Institute, Texas AandM University, College Station, Texas 77843). *Phys. Rev., A;* **12**: No. 6, 2628-2630(Dec 1975).

The description of internal ionization during α decay, as developed by Hansen, is reexamined and extended to the calculation of the ejected-electron energy distributions. The results are compared with recent experimental data for the decay of ^{210}Po. (AIP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9886

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9827, 9963

9892 **Finite-range calculation for the two-step reaction ^{208}Pb(p, d)^{207}Pb(d, t)^{206}Pb(3$^+$).** Charlton, L.A. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). *Phys. Rev. Lett.;* **35**: No. 22, 1495-1497(1 Dec 1975).

An exact finite-range calculation of the differential cross section has been performed for the two-step process ^{208}Pb(p,d)^{207}(d,t) ^{206}Pb(3$^+$). It is found that finite-range theory differs from the conventional zero-range results by 20 to 40%, depending on the scattering angle. (AIP)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 9867, 9968, 9969

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9967

9893 (ORO—3346-173, pp 10-11) **Experimental nuclear decay scheme studies on campus.** 31 Oct 1975.

In Nuclear and x-ray spectroscopy with radioactive sources. Eleventh annual progress report, February 1, 1975—January 31, 76.

Research progress in decay scheme studies of transuranium nuclides, ^{190}Pt, ^{149}Nd and measurements of E2 and M4 K conversion coefficients are reported. (SDF)

ENERGY LEVELS AND TRANSITIONS

9894 (ORO—3346-173, pp 12-24) **Current UNISOR research.** 31 Oct 1975.

In Nuclear and x-ray spectroscopy with radioactive sources. Eleventh annual progress report, February 1, 1975—January 31, 1976.

Progress in spectroscopic studies at UNISOR of mass chains A = 185 through 197, and studies of A = 115, 116, and 117 isobars are reported. (SDF)

9895 **Evidence for giant M2 states in ^{208}Pb.** Lindgren, R.A.; Bendel, W.L.; Fagg, L.W.; Jones, E.C. Jr. (Naval Research Laboratory, Washington, D.C. 20375). *Phys. Rev. Lett.;* **35**: No. 21, 1423-1425(24 Nov 1975).

Transitions to states in ^{208}Pb at 7.40 and 7.91 MeV excitation are suggested to be components of a giant magnetic quadrupole resonance in ^{208}Pb. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9621, 9817, 9835, 9859, 9863, 9882, 9883, 9895

9896 (BNL-NCS—50446, pp 174-191) **^{197}Au(n,γ)^{198}Au reaction for ENDF/B-IV.** Goldberg, M.D.; Mughabghab, S.F. Apr 1975.

In ENDF/B-IV dosimetry file.

The ^{197}Au neutron capture cross section is reevaluated for neutron energies greater than 25 keV using new available data. (SDF)

9897 (ORO—4856-26, pp 597-598) **Strongly damped collisions in the ^{84}Kr + ^{209}Bi reaction.** Viola, V.E. Jr. (Univ. of Maryland, College Park); Wolf, K.L.; Unik, J.P.; Huizenga, J.R.; Birkelund, J.; Freiesleben, H. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Information on a new reaction mechanism, characterized by strongly damped collisions (SDC), is presented for bombardments of ^{209}Bi with ^{84}Kr ions from the Berkeley SuperHILAC. This process accounts for a significant fraction of the reaction cross section in interactions between heavy target nuclei and projectiles of ^{40}Ar and heavier. The exit channel properties of the strongly damped collisions exhibit the following features: two fragments are emitted with masses near those of the target and projectile, although exchanges of several nucleons can occur; strong damping of the energy degree of freedom is observed; fragment energies are characteristic of deformed fission fragments, representing an attenuation of 100-150 MeV in the entrance channel energy, and the angular distribution for the ^{84}Kr-like product is strongly peaked at an angle near the classical grazing angle. Measurements have been conducted with 600-MeV and 714-MeV ^{84}Kr ions. These are compared with the work of Hanappe et al. at 525 MeV. (auth)

9898 **Measurements of the neutron capture cross sections of gold-197 and uranium-238 between 20 and 3500 keV.** Poenitz, W.P. (Argonne National Lab., IL). *Nucl. Sci. Eng.;* **57**: No. 4, 300-308(Aug 1975).

Absolute measurements of the capture cross section of ^{197}Au were carried out in the 400- to 3500-keV energy range. Ratios of the capture cross sections of ^{238}U to ^{197}Au were measured from 20 to 1200 keV. Values for ^{238}U were derived by utilizing evaluated and present data for ^{197}Au. The time-of-flight technique and a large liquid scintillator were used for the detection of the prompt capture gamma rays, and the Grey Neutron Detector, the Black Neutron Detector, and a ^{6}Li-glass detector were used for the measurement and monitoring of the neutron flux. Results support previous measurements of the ^{238}U capture cross section and

resolve some existing discrepancies. The absolute values for the capture cross section of ^{197}Au agree well with evaluated data and measurements reported relative to the ^{235}U fission cross section. (7 figures, 3 tables) (auth)

9899 **Heavy ion elastic scattering survey. I. ^{208}Pb target.** Ball, J.B.; Fulmer, C.B.; Gross, E.E.; Halbert, M.L.; Hensley, D.C.; Ludemann, C.A.; Saltmarsh, M.J.; Satchler, G.R. (Oak Ridge National Lab., Tenn. (USA)). *Nucl. Phys., A;* **252**: No. 1, 208-236(3 Nov 1975).

Differential cross sections for elastic scattering of ^{12}C ions of 96 MeV, ^{16}O ions of 129.5 and 192 MeV, and ^{20}Ne ions of 161.2 MeV from ^{208}Pb were measured and analyzed using the optical model. Values of the real potential near the strong absorption radii were extracted and some constraints put on its slope. Some information on the slope of the imaginary potential in this region was also obtained, while the magnitude of the imaginary potential here was found to be comparable to that for the real potential. The scattering was found to be almost completely insensitive to the real or imaginary potential for center-of-mass separations less than approximately 10 fm. In addition to Woods—Saxon potentials, folded-model potentials were also used, and a consistent description of the present and other data was obtained with a Gaussian nucleon—nucleon interaction. It was found that a nucleon—nucleon interaction with a range as long as that for one-pion-exchange is unacceptable. (NL)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 9919

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9967

NUCLEAR REACTIONS AND SCATTERING

9900 (BNL-NCS—50451, pp 87-94) **Adjustment of the effective ^{238}U resonance integral to force agreement with integral data.** Edenius, M. (AB Atomenergi, Studsvik, Sweden). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

A resonance treatment in an advanced cell code (CASCO) is used to calculate the resonance absorption in isolated fuel rods surrounded by a large moderating region and to normalize the calculated resonance integrals to experimentally determined expressions for the resonance integral. Corrections to the effective ^{238}U resonance integral are suggested and examples of how such corrections improve lattice calculations are given. (SDF)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 9968, 9971

9901 (ORO—4856-26, pp 593-594) **Anomalies in the fission of Fermium.** Goennenwein, F.; Schultheis, H.; Schultheis, R.; Wildermuth, K. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

An analysis on the basis of cluster representations shows that the observed anomalies in the fission of Fermium are due to substructure effects. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9967

ENERGY LEVELS AND TRANSITIONS

9902 **Lifetimes of rotational states in ^{232}Th.** Johnson, N.R.; Sturm, R.J.; Eichler, E.; Guidry, M.W.; O'Kelley, G.D.; Sayer, R.O.; Hensley, D.C.; Singhal, N.C.; Hamilton, J.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., C;* **12**: No. 6, 1927-1936(Dec 1975).

Lifetimes of the 4^+ through 10^+ member of the ground-state rotational band in ^{232}Th have been measured by the Doppler-shift recoil-distance technique. These states were Coulomb excited by 152-MeV ^{40}Ar ions, and measurements were carried out in coincidence with the backscattered projectiles. The half-lives for the 4^+ through 10^+ states are 164 plus-or-minus 9, 66.2 plus-or-minus 3.6, 25.1 plus-or-minus 1.0, and 11.2 plus-or-minus 1.7 ps, respectively. The B (E2) values deduced for these states are systematically about 10% smaller than rigid-rotor values; however, the constancy of the transition quadrupole moments is interpreted as an indication of rotational behavior. (AIP)

9903 **Sign of the E4 moment in ^{236}U by multiple Coulomb excitation with ^{40}Ar ions.** Guidry, M.W.; Eichler, E.; Johnson, N.R.; O'Kelley, G.D.; Strum, R.J.; Sayer, R.O. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., C;* **12**: No. 6, 1937-1944(Dec 1975).

Multiple Coulomb excitation with ^{40}Ar projectiles has been used to excite the ground state rotational band of ^{236}U through the 12^+ state. A comparison of the experimental and theoretical excitation probabilities confirms a positive value for the E4 moment, removing the sign ambiguity inherent in the determination of this moment by α-particle Coulomb excitation. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9721, 9835, 9884, 9898, 9902, 9903

9904 (BNL-NCS—50446, pp 192-206) **^{232}Th cross section evaluation for ENDF/B-IV.** Wittkopf, W.A. Apr 1975.

In ENDF/B-IV dosimetry file.

The cross sections for neutron capture and fission of ^{232}Th have been evaluated for ENDF/B-IV. (SDF)

9905 (BNL-NCS—50446, pp 207-285) **Neutron cross section tabulated data.** Apr 1975.

In ENDF/B-IV dosimetry file.

Evaluations of cross sections for the reactions ^{235}U(n,f), ^{238}U(n,f), ^{238}U(n,γ), ^{237}Np(n,f), and ^{239}Pu(n,f) are given. (SDF)

9906 (BNL-NCS—50451) **Seminar on ^{238}U resonance capture, Upton, New York, March 18—20, 1975.** Pearlstein, S. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. Contract E(30-1)-16. 264p. (CONF-750323—; ENDF—217; NEACRP-L—147; NEANDC(US)—192/L; INDC(US)—69/L). Dep. NTIS $11.25.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

21 papers are abstracted separately and appear in both Nuclear Science Abstracts and ERDA Research Abstracts. (SDF)

9907 (BNL-NCS—50451, pp 45-66) **Current UK position on ^{238}U resonance capture.** Askew, J.R. (Atomic Energy Establishment, Winfrith, Eng.). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

The paper reviews the large body of integral evidence on uranium-238 resonance capture accumulated since 1966, when attention was first drawn to a discrepancy between integral evidence and calculated results based upon differential data. The experiments cover many reactor types, laboratories and measurement techniques, and include studies of isotopic composition of discharge fuel. It is shown that the discrepancy still exists, although changes in other data (particularly uranium-235 resonance capture) have reduced the size of the deduced discrepancy to 4 to 8 percent. It is argued that the differences are within the uncertainties of measurement of parameters for the low lying resonances which dominate thermal reactor calculations. These were originally believed to be more accurate because it was thought acceptable to assume capture widths invariant and to average them over many resonances. Once this is not permitted the difference become explicable. 2 figures, 13 tables. (auth)

9908 (BNL-NCS—50451, pp 81-86) **Effective ^{238}U resonance integrals in clusters of natural uranium fuelpins derived from CRNL lattice measurements.** Griffiths, J. Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Lattice parameters, fast fission ratio, initial conversion ratio, thermal neutron fine structure, thermal neutron spectrum parameters and buckling, have been measured at CRNL for a wide range of natural uranium lattices. The lattices consisted of regular arrays of fuel clusters, containing natural U metal, UO_2, UC, U_3Si/Al cooled by D_2O, AIR, organic liquid and in a few cases H_2O, in D_2O moderator, for a wide range of lattice pitches. ^{238}U resonance absorption rates in these lattices can be derived from the lattice parameters. These absorption rates have been related to effective ^{238}U resonance integrals by means of the EPITHET computer code. (auth)

9909 (BNL-NCS—50451, pp 95-102) **Precise measurement and calculation of ^{238}U neutron transmissions.** Olsen, D.K.; de Saussure, G.; Silver, E.G.; Perez, R.B. (Oak Ridge National Lab., TN). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

The total neutron cross section of ^{238}U has been measured above 0.5 eV in precise transmission experiments and results are compared with ENDF/B-IV. Emphasis has been on measuring transmissions through thick samples in order to obtain accurate total cross sections in the potential-resonance interference regions between resonances. 4 figures, 1 table. (SDF)

9910 (BNL-NCS—50451, pp 103-121) **$^{238}U(n,\gamma)$ cross section above the resonance region.** Perez, R.B.; Spencer, R.R.; de Saussure, G. (Oak Ridge National Lab., TN). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

A number of measurements of the $^{238}U(n,\gamma)$ cross section above the resonance region have been completed in the past few years. In the keV range, these measurements suggest a considerable amount of intermediate structure. Comparisons are made of pre-1970 and more recent evaluations with ENDF/B-IV results. Discrepancies and uncertainties are discussed. (SDF)

9911 (BNL-NCS—50451, pp 122-146) **Evaluation of ^{238}U cross sections for ENDF/B-IV.** McCrosson, F.J. (E. I. du Pont de Nemours and Co., Aiken, SC). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Evaluation of ^{238}U neutron cross sections below 4 keV is discussed, emphasizing thermal and epithermal cross sections, s and p wave resonances, background cross sections, and the impact of new ENDF/B-IV evaluations on thermal lattice calculations. Several possible deficiencies in the Version III ^{238}U cross sections have been proposed. 15 tables. (SDF)

9912 (BNL-NCS—50451, pp 147-150) **Comments on the ^{238}U discrepancy.** Chrien, R.E. (Brookhaven National Lab., Upton, NY). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

The problem of overprediction of neutron capture by ^{238}U using commonly accepted resonance parameters from the ENDF/B-IV file is briefly considered. (SDF)

9913 (BNL-NCS—50451, pp 151-155) **Capture width of the 6.67 eV level in ^{238}U.** de Saussure, G.; Perez, R.B. (Oak Ridge National Lab., TN). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

In a comparison between a Monte Carlo calculation and a measurement of the capture probability in a thick sample of ^{238}U it has been suggested that the width of the 6.67 eV level might be appreciably smaller than the value 25.6 MeV, evaluated in Version III and IV of ENDF/B. A few comments are made on this topic. (SDF).

9914 (BNL-NCS—50451, pp 163-166) **Review of benchmark experiments.** Sher, R.; Fiarman, S. (Stanford Univ., New York). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

Some possible systematic errors in reaction rate measurements in lattices are discussed, which might be correctable, even at this late date. These include streaming through catcher foils or gaps, fast source perturbations due to the use of depleted uranium detectors and cadmium, and cadmium cut-off effects. (auth)

9915 (BNL-NCS—50451, pp 255-264) **^{238}U resolved resonance parameters and their influence on capture cross-sections.** Bhat, M.R. (Brookhaven National Lab., Upton, NY). Mar 1975.

From Proceedings of 238U resonance capture; Upton, New York, USA (18 Mar 1975).

In Seminar on the ^{238}U resonance capture.

The experimental data on the resonance parameters of the first four resolved resonances of ^{238}U are reviewed. The purpose of such a review is (1) to estimate the errors in the resonance parameters and (2) to determine how far the parameters could be reasonably changed within the bounds determined by the experimental uncertainties in the thermal capture cross-section and the infinitely dilute resonance capture integral. The effect of changing the gamma width of the individual resonances is studied and its effect on the effective resonance integral determined. 2 tables. (auth)

9916 (ORO—4856-26, pp 358-359) **Gamma-ray production cross-sections from the interaction of 140 MeV alpha-particles with ^{232}Th.** Hornyak, W.F.; Chang, C.C.; Walters, W.B.; Holmgren, H.D. (Univ. of Maryland, College Park). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

In a preliminary experiment using a metallic ^{232}Th target bombarded with 140 MeV α-particles, some γ-rays were tentatively identified, in an observed array of well over 200 lines, originating in residual nuclides corresponding to near-symmetric fission and the population of the principal Th-decay chain elements. Time gated spectra were observed in the manner described in the paper on Al + α, Part I, to permit assigning both "prompt" and "delayed" yields. Severe background problems and the high multiplicity of observed lines render most of the presently quoted assignments tentative. (auth)

9917 **Small-angle scattering of 7—14-MeV neutrons by Pb and U.** Bucher, W.P.; Hollandsworth, C.E. (U. S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland 21005). *Phys. Rev. Lett.*; **35**: No. 21, 1419-1422(24 Nov 1975).

Absolute cross sections for neutrons elastically scattered through small angles by Pb and U have been accurately measured at various energies in the range 7—14 MeV. The results disagree with many previously reported measurements and especially their interpretations regarding anomalous scattering. However, optical-model predictions based on the energy-independent, nonlocal potential of Perey and Buck are, apart from normalization, in agreement with the present measurements for Pb. (AIP)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 8573

9918 (ORO—4856-26, pp 591-592) **Mass and kinetic energy distributions in MeV neutron induced fission of ^{232}Th, ^{235}U and ^{238}U.** Holubarsch, W.; Goennenwein, F. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9919 **Measurement of pre- and post-fission neutron emission at moderate excitation energies.** Fraenkel, Z.; Mayk, I.; Unik, J.P.; Gorski, A.J.; Loveland, W.D. (Argonne National Laboratory, Argonne, Illinois 60439 and Weizmann Institute of Science, Rehovot, Israel). *Phys. Rev., C;* **12**: No. 6, 1809-1825(Dec 1975).

Fission fragment mass-energy distributions and the coincident neutron velocity distributions have been measured for ^{209}Bi, ^{232}Th, ^{233}U, ^{238}U, and ^{239}Pu bombarded with 45 MeV α particles and ^{226}Ra bombarded with 16 MeV protons. The number of pre-fission neutrons and the number of post-fission neutrons were obtained as a function of fragment mass and total fragment kinetic energy. The average number of pre-fission neutrons emitted is 2.9plus-or-minus0.9 for the ^{232}Th target, 3.3plus-or-minus1.5 for ^{233}U, 3.6plus-or-minus1.6 for ^{238}U, and 2.7plus-or-minus0.8 for ^{239}Pu. The average number of post-fission neutrons emitted by these systems is 4.4plus-or-minus0.3, 4.2plus-or-minus0.7, 4.6plus-or-minus0.7, and 5.1plus-or-minus0.3, respectively. (The values reported for pre-fission neutrons include also contributions from scission neutrons.) The number of pre-fission neutrons from the ^{226}Ra+16 MeV proton system is 0.5plus-or-minus0.3. The number of post-fission neutrons is 3.6plus-or-minus0.4. The number of neutrons emitted from the ^{209}Bi+45 MeV α particle system is 3.6plus-or-minus0.2. The number of post-fission neutrons as a function of fragment mass and total kinetic energy which were obtained by the direct neutron measurements are more consistent with calculated total energy balances than the values obtained by

the indirect method. The agreement between the calculated results and our experimental results is satisfactory. However, the calculations predict spallation cross sections which are much larger than those obtained experimentally. (AIP)

9920 Parameters of the subthreshold fission structure in ^{240}Pu. Auchampaugh, G.F.; Weston, L.W. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **12**: No. 6, 1850-1857(Dec 1975).

The neutron subthreshold fission cross section of ^{240}Pu has been measured from 500 to 10 000 eV using the Oak Ridge electron linear accelerator neutron facility. A total of 82 fission widths were obtained from area and shape analysis of those resonances which define the class II states at ≅ 782, ≅ 1405, ≅ 1936, and ≅ 2700 eV. The average square of the coupling matrix element for the first three class II states is 1.85 plus-or-minus 1.43 eV^2 standard deviation (SD). The average class II fission width is 2.5 plus-or-minus 1.0 eV (SD). Approximately 22 clusters of class I resonances were observed below 10 keV, which results in a value of 450 plus-or-minus 50 eV for the average class I level spacing. Assuming parabolic inner and outer barriers, the following barrier parameters were obtained: V/subA/ - B/subn// h ω/subA/ = 0.71$^{+0.21}$sub -//sub 0/./sub 0//sub 9/ and V/subB/ - B/subn// h ω/subB/ = 0.53$^{+0.09}$/sub -//sub 0/./sub 0//sub 6/. (AIP)

NUCLEAR THEORY

9921 Pion-exchange contributions to the isoscalar charge operator. Friar, J.L. (Brown Univ., Providence, R.I. (USA). Dept. of Physics). *Phys. Lett., B;* **59**: No. 2, 145-149(27 Oct 1975).

Pion-exchange contributions to the isoscalar part of the charge operator are studied using the equivalence theorem and time-dependent perturbation theory. (NL)

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 9901

9922 (ORO—4856-26) **Clustering phenomena in nuclei: II. Invited lectures and contributed papers from the second international conference on clustering phenomena in nuclei, College Park, Maryland, 21—25 April 1975.** Goldberg, D.A.; Marion, J.B.; Wallace, S.J. (eds.). (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1975. 651p. (CONF-750447—). Dep. NTIS $13.60.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

Invited lectures and contributed papers on clustering phenomena are presented. Topics include general aspects of clustering phenomena, reaction theory, light nuclei, elastic and quasi-elastic scattering, exotic and energetic reactions, multinucleon transfer and cluster spectroscopy, molecular states, and fission, fusion, and alpha decay. Separate abstracts are prepared for the 128 items included in these proceedings. (BJG)

9923 (ORO—4856-26, pp 3-22) **Survey of intrinsic states of light nuclei.** Brink, D.M. (Univ. of British Columbia, Vancouver, Can.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The resonating group method and the generator coordinate method are two closely related theories of nuclear structure which can be used to construct wave functions describing cluster structures. In both cases the form of the intrinsic state implies a selection of those degrees of freedom which are regarded as being important for the problem under consideration. The form of the intrinsic state also corresponds to a particular truncation of the shell model space. In the resonating group method the effect of the Pauli principle leads to forbidden or redundant states of relative motion of clusters. An improved understanding of the role of forbidden states in the theory has led to important advances in the phenomenological description of cluster structures in nuclei. 3 tables, 2 figures (auth)

9924 (ORO—4856-26, pp 23-37) **Survey of shell model two and four nucleon correlations.** Gillet, V. (CEN, Saclay, France). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Shell model strong and weak bonds in nuclei are discussed. This problem concerns in particular the recent fragmentation experiments of medium and heavy nuclei. They are induced by the scattering of high energy projectiles (p,π,α...) or the atomic capture of pions or kaons. Nucleons in space symmetric states have greatly enhanced interactions because of the exchange and short range nature of nuclear forces. This fact leads not only to cluster models in light nuclei but also to specific 2 and 4 nucleon substructures in the shell model of medium and heavy nuclei. These correlations are approached by examining the following two points: 1. Strong and weak bonds between core nucleons described by a spherical j-j coupling Hartree-Fock state. 2. Strong and weak bonds between valence nucleons as shown by (a) the fine structure of the mass curve; (b) shell model configuration mixing calculations; (c) aligned or pairing schemes. Core and valence nucleons must be distinguished because in the latter case the pairing and alignment effects of nuclear forces can fully play in paired or aligned structures. The way these effects yield stable sub-structures in closed j shells require a special treatment. It is convenient to define as a "quartet" any group of two protons and two neutrons whose mutual interactions are much stronger than their interactions with the remaining nucleons of the system, whatever their space correlation or relative quantum numbers. (auth)

9925 (ORO—4856-26, pp 38-55) **Surface clustering.** Arima, A. (Tokyo Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A shell model cluster and a localized cluster are defined. Enhancement of clustering at the nuclear surface is predicted by extended shell model calculations and cluster model calculations. Experimental evidence of the surface clustering is shown. Many-particle, many-hole excitations are discussed in connection with the surface clustering. 8 tables, 7 figures, 45 references. (auth)

9926 (ORO—4856-26, pp 56-65) **Symmetries of cluster configurations.** Kramer, P. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A deeper understanding of clustering phenomena in nuclei must encompass at least two interrelated aspects of the subject: (A) Given a system of A nucleons with two-body interactions, what are the relevant and persistent modes of clustering involved. What is the nature of the correlated nucleon groups which form the clusters, and what is their mutual interaction. (B) Given the cluster modes and their interaction, what systematic patterns of nuclear structure and reactions emerge from it. Are there, for example, families of states which share the same "cluster parents". Which cluster modes are compatible or exclude each other. What quantum numbers could characterize cluster configurations. There is no doubt that we can learn a good deal from the experimentalists who have discovered many of the features relevant to aspect (B). Symmetries specific to cluster configurations which can throw some light on both aspects of clustering are discussed. (auth)

9927 (ORO—4856-26, pp 67-68) **Cluster states in light nuclei in a folded potential model.** Buck, B. (Oxford Univ.); Dover, C.B.; Vary, J.P. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A model is outlined for three and four particle cluster states in light nuclei, in which such states are considered as bound states and resonances of a cluster-core folded potential. The energy spectra, B(E2) values, α widths and r.m.s. radii of these states are calculated for ^{16}O and ^{20}Ne, and are in good agreement with experiment. The model is also used to provide dynamical support for high spin assignments for states in ^{15}N and ^{15}O seen strongly in heavy ion three particle transfer reactions. The model is also useful as a predictive tool in estimating the energies of other high spin cluster states in a variety of nuclei. (auth)

9928 (ORO—4856-26, pp 77-78) **Application of the stochastic variational method to the calculation of 3α- and 4α-systems.** Kukulin, V.I.; Krasnopol'skii, V.M. (Moscow State Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The results of calculations of the properties of 3α- and 4α-systems carried out within the framework of the recently suggested stochastic variational method are presented. As the α-α potentials, two different types of potentials are used: the Ali-Bodmer repulsive core potential and the deep attractive α-α potential with forbidden states. In the latter case the pseudopotential approach we have earlier suggested is used. The energies of levels, ⟨r^2⟩ and form-factors of the ground state F(q^2) are calculated. (auth)

9929 (ORO—4856-26, pp 148-149) **Positive energy bound states in the cluster model.** Clement, D.; Schmid, E. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9930 (ORO—4856-26, pp 150-151) **Influence of the continuum on the widths of resonance levels.** Barz, H.W.; Rotter, I. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9931 (ORO—4856-26, pp 157-158) **Pseudo-potential method for taking into account the Pauli principle in cluster systems.** Krasnopol'skii, V.M.; Kukulin, V.I. (Moscow State Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

In order to take account of the Pauli principle in cluster systems (such as 3α, $\alpha + \alpha + n$) a convenient method of renormalization of the cluster-cluster deep attractive potentials with forbidden states is suggested. The renormalization consists of adding projectors upon the occupied states with an infinite coupling constant to the initial deep potential which means that we pass to pseudo-potentials. The pseudo-potential approach in projecting upon the noneigenstates is shown to be equivalent to the orthogonality condition model of Saito et al. The orthogonality of the many-particle wave function to the forbidden states of each two-cluster sub-system is clearly demonstrated. (auth)

9932 (ORO—4856-26, pp 167-181) **Cluster model revisited.** Tombrello, T.A. (California Inst. of Tech., Pasadena). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A selective review is presented of recent data that bear upon cluster phenomena in several light nuclei. Rather than attempting to provide a general catalog of such examples, I shall mainly emphasize those open questions, whose answers may provide a more definitive view of nuclear clustering. To this end, particular states of mass 4, 5, 6, 7, and 8 nuclides will be examined. 8 figures. (auth)

9933 (ORO—4856-26, pp 439-452) **Cluster spectroscopic factors: concept and practice.** Kurath, D. (Argonne National Lab., IL). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The cluster spectroscopic amplitude is defined and related to the shell model expression for this quantity. The SU_3 representation is particularly suited for transfer of spatially symmetric clusters. Some examples of heavy ion and light ion transfer reactions are given wherein an SU_3 nuclear structure analysis indicates that such cluster transfer is the dominant feature. (auth)

9934 (ORO—4856-26, pp 454-455) **Alpha-particle size effects on alpha spectroscopic amplitudes.** Hecht, K.T.; Sato, H. (Univ. of Michigan, Ann Arbor). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9935 (ORO—4856-26, pp 460-461) **Alpha-deuteron vertex constant of ^{6}Li.** Lim, T.K. (Drexel Univ., Philadelphia). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The alpha-deuteron structure of the ground state of ^{6}Li has been studied theoretically through phenomenological, resonating-group structure, shell model, and pole approximation methods. The asymptotic normalization constant of the α-d intercluster wave function is directly related to the ^{6}Li:-α-d vertex constant C. Tabulated values of C^2 are given and possible sources of errors are discussed. 22 references (BJG)

9936 (ORO—4856-26, pp 465-499) **Nuclear molecular states.** Bromley, D.A. (Yale Univ., New Haven). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Molecular phenomena occurring in heavy ion collisions are examined. (BJG)

9937 (ORO—4856-26, pp 500-521) **Nuclear molecular states.** Abe, Y. (Kyoto Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The effects of polarization on the stability of α-cluster structures in ^{8}Be and ^{12}C nuclei are studied in the intrinsic states. The extent of the polarization of α-clusters is investigated by employing a molecular-orbital model. Two α-cluster structure of ^{8}Be is shown to be extremely stable, and a triangular configuration of three α-clusters is also shown to be stable, but the polarizations of α-clusters are found rather large. Gruemmer—Faessler's method is discussed and their results are shown to be trivial. (auth)

9938 (ORO—4856-26, pp 542) **Self-consistent calculations for highly constricted nuclear shapes, demonstrated for ^{16}O+^{16}O.** Zint, P.G.; Passler, K.H.; Mosel, U. (Univ., Giessen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9939 (ORO—4856-26, pp 543-544) **Tri-nuclear cluster structures mediated by an alpha-particle.** Ikeda, K.; Suzuki, Y. (Niigata Univ., Japan). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The theoretical arguments for the possible existence of the tri-nuclear cluster structures in connection with the empirical properties of these molecular resonances in ^{12}C + ^{16}O scattering are reviewed. (auth)

9940 (ORO—4856-26, pp 545-546) **Search for an aligned structure of the type ^{12}C + α + ^{12}C at high excitation energy in ^{28}Si.** Scheurer, J.N. (CEN, Bordeaux—Gradignan, France); Burnereau, N.; Bertault, D.; Quebert, J.L.; Fouan, J.P. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9941 (ORO—4856-26, pp 549-561) **Many nucleon correlations in light nuclei.** Harvey, M. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A demonstration is presented of how simple "back-of-the-envelope" considerations help in the understanding of how nucleons behave in a clustering environment. The compatability of different model representations of the same many nucleon states is discussed. (auth)

9942 **Calculations of harmonic oscillator brackets.** Feng, D.H.; Tamura, T. (Texas Univ., Austin (USA). Center for Nuclear Studies). *Comput. Phys. Commun.*; **10**: No. 2, 87-97(Aug 1975).

Oscillator brackets are used in various aspects of nuclear structure and reaction calculations. The program calculates these very rapidly. The method is to use a closed form for an oscillator bracket as given by Baranger and Davies (1966), and then to calculate simultaneously a large number of brackets that have different sets of principal quantum numbers for a given set of angular-momentum quantum numbers. Restrictions come about only through the size of the core storage assigned by the DIMENSION statements. The storage presently assigned will meet the needs of most present-day nuclear physics calculations. The running time of the program ranges roughly from 600 to 1000 brackets per second of CP time on the CDC 6600 computer at the computer center of the University of Texas. (NL)

9943 **Interpretation of decoupled bands by the weak coupling model.** Tanaka, Y.; Sheline, R.K. (Florida State Univ., Tallahassee (USA). Dept. of Physics). *Phys. Lett., B;* **58**: No. 4, 414-416(29 Sep 1975).

The band structure and mechanism of formation of odd-A decoupled rotational bands are studied using the weak coupling model of de-Shalit. The geometrical relation between the spin of the core and the particle can be shown explicitly because of the fact that the interaction matrix elements are written in terms of the angle between these two spins. This scheme is shown to be a good representation in describing decoupled bands and to have wave functions with large overlaps with those resulting from the coupling scheme introduced by Stephens. (NL)

9944 **Interpretation of inversions of single-particle levels in self-consistent field theories.** Becker, R.L.; Svenne, J.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., C;* **12**: No. 6, 2067-2071(Dec 1975).

An interpretation is offered for the level inversion that usually occurs in self-consistent field calculations when only one of a pair of symmetry-related levels is occupied: the single-particle energy of the level unoccupied in the A-particle system is its energy of removal from the (A + 1) -particle system. The correction of this energy to convert it to the corresponding energy in system A is simply given. When both symmetry-related levels are calculated in the same system there is no level inversion. The prescription to occupy the lowest levels should be amended to state that the energies should all correspond to removal energies from system A. (AIP)

9945 Calculation of the mass parameter in the theory of self-cranked generator coordinates. Wilets, L.; Tuerpe, D.R.; Haff, P.K. (Department of Physics, University of Washington, Seattle, Washington 98195). *Phys. Rev., C;* **12**: No. 6, 2088-2093(Dec 1975).

The self-cranked generator coordinate (SCGC) method of Haff and Wilets, together with constrained Hartree-Fock-Bogoliubov wave functions, has been used to calculate the mass parameter B/subQ/ for quadrupole deformations. A simple ansatz reduces the required integrals to a form similar to that required in Hartree-Fock calculations, and the same matrix elements of the Hamiltonian occur in both cases. The results are sensitive to numerical approximations and care must be exercised to maintain accuracy. Since the SCGC method adds another variational function, the energy is lowered relative to the usual generator coordinate method, and hence B/subQ/ is increased. For a particular sample calculation, the correction more than doubled B/subQ/. (AIP)

NUCLEAR MATTER

9946 Equation of state for neutron matter at finite T in a relativistic mean-field theory. Walecka, J.D. (Stanford Univ., Calif. (USA). Inst. of Theoretical Physics). *Phys. Lett., B;* **59**: No. 2, 109-112(27 Oct 1975).

The equation of state for neutron matter at all temperatures is presented in a relativistic mean-field theory which describes known nuclear matter. Isotherms are calculated and discussed, and some limiting analytic forms of the equation of state are given. (NL)

9947 Quasiparticle pole strength in nuclear matter. Poggioli, R.S.; Jackson, A.D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Rev. Lett.;* **35**: No. 18, 1211-1213(3 Nov 1975).

It is argued that single-particle-like behavior in nuclear matter is much less probable than Brueckner theory suggests. In particular, the quasiparticle pole strength is evaluated for nuclear matter and it is shown that, contrary to the spirit of Brueckner theory, low-momentum states play a crucial role in determining the magnitude of z/sub k/sub F//. (AIP)

9948 Solidification of neutron matter. Canuto, V.; Lodenquai, J. (Insitute for Space Studies, National Aeronautics and Space Administration, New York, New York 10025). *Phys. Rev., C;* **12**: No. 6, 2033-2037(Dec 1975).

A new parity-conserving equation of motion is used to evaluate the ground state of a system of high density neutrons in a quantum crystal. If one form of a purely repulsive NN potential is employed, the ground state energy has a minimum with respect to the localization parameter in the density range appropriate to neutron star interiors, whereas it does not if a realistic NN potential is used. However, the values of the localization parameters α^{-1}/subm/ corresponding to the observed minima are very close to or even less than the separation Δ between neutrons. Since the method employed here for the solid is only reliable when α/subm/ $\Delta > 1$, one cannot definitely say that an equilibrium solid state exists even in this case. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9691, 9922, 9974, 9976

9949 (ORO—4856-26, pp 107-118) **Fundamentals of nuclear reactions analyzed with the help of microscopic calculations.** Hackenbroich, H.H. (Univ., Cologne). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Basic ideas of microscopic calculations of nuclear reactions are briefly stated; the main topic will be the discussion of some calculations for light nuclear systems and their consequences for the understanding of nuclear reaction mechanisms. (auth)

9950 (ORO—4856-26, pp 119-143) **Scattering and reaction calculations with the resonating-group method.** Tang, Y.C.; Thompson, D.R. (Univ. of Minnesota, Minneapolis). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Over the past years, many scattering and reaction calculations using the resonating-group method have been performed. These calculations have yielded not only satisfactory agreement with experimental results but also valuable knowledge concerning especially the importance of the Pauli principle in nuclear systems. The progress made in this field is reviewed, the information one has learned from these calculations is discussed, and the types of problems currently accessible to this approach are indicated. (auth)

9951 (ORO—4856-26, pp 146-147) **New cluster model of nuclear reactions.** Redish, E.F.; Tandy, P.C. (Univ. of Maryland, College Park). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9952 (ORO—4856-26, pp 152-153) **Symmetry of the T matrix in reactions producing an isobaric multiplet.** Braun-Munzinger, P.; Gelbke, C.K.; Harney, H.L.; Agassi, D. (Max-Planck-Institut fuer Kernphysik, Heidelberg). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9953 (ORO—4856-26, pp 154-155) **Approximate calculation of breakup amplitudes in the unified microscopic nuclear theory.** Schwager, J. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9954 (ORO—4856-26, pp 222-223) **Effective interaction and the ion—ion interaction energy.** Sinha, B. (King's Coll., London). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9955 (ORO—4856-26, pp 224) **Exchange contributions to proton inelastic scattering from collective nuclei.** Tedder, P.W.; Edwards, V.R.W.; Sinha, B.C. (King's Coll., London). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The residual potential which, in the DWBA, leads to the excitation of low-lying collective states has previously been calculated by deforming the phenomenological optical potential which had reproduced the observed elastic scattering. An alternative method is to deform the nuclear density distribution and then to fold this into a nucleon-nucleon effective interaction. (auth)

9956 (ORO—4856-26, pp 227) **Exchange effects due to the Pauli principle on interaction between nuclei.** Ando, T. (Hokkaido Univ., Sapporo); Ikeda, K.; Suzuki, Y. 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9957 (ORO—4856-26, pp 281-290) **Quasielastic knock-out of clusters: theory.** Balashov, V.V. (Moscow State Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Quasielastic cluster knock-out reactions and their role in nuclear reaction theory are reviewed. 7 figures, 16 references (BJG)

9958 (ORO—4856-26, pp 299-300) **Role of spin-orbit distortion in the theory of knock-out reactions.** Jackson, D.F. (Univ. of Surrey, Guildford, Eng.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9959 (ORO—4856-26, pp 437-438) **Simplified phenomenology of cluster-transfer reactions.** Noble, J.V. (Univ. of Virginia, Charlottesville). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

A simple approximation for cluster-transfer reaction amplitudes in the framework of the strong absorption model is derived by making use of the observation that the PWBA amplitudes for many such reactions are strongly forward-peaked and can be represented by an exponential in cos theta. (auth)

9960 **Generalizations of distorted wave impulse approximation for nuclear (π^+,π^0) reactions.** Eisenberg, J.M.; Gal, A. (Hebrew Univ., Jerusalem (Israel). Dept. of Physics). *Phys. Lett., B;* **58**: No. 4, 390-394(29 Sep 1975).

It is shown that corrections to the ordinary distorted-wave impulse approximation are uniquely important for (π^+,π^0) reactions in the 3,3 region and have a significant effect toward improving agreement with the existing experiments. (NL)

9961 **Dispersion corrections to elastic electron scattering and the closure approximation.** DeForest, T. Jr. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)); Friar, J.L. (Brown Univ., Providence, R.I. (USA). Dept. of Physics). *Phys. Lett., B;* **58**: No. 4, 397-401(29 Sep 1975).

It is shown that, in contrast to the pure closure approximation, the corrected closure approximation of Friar and Rosen is not very sensitive to the value of the excitation energy ω and is in good agreement with the exact results as long as ω is reasonably small. Calculations of the effective excitation energy which should be used in the pure closure approximation show that this quantity tends to be quite small and, except for very small momentum transfers, has little resemblance with the intuitive concept of an average excitation energy. Arguments have been presented which indicate that the results of the present calculation are probably representative of all dispersion calculations and not simply a feature of the harmonic oscillator shell model which we have used. (NL)

9962 **Critique of folded potential for heavy-ion scattering.** Satchler, G.R. (Oak Ridge National Lab., Tenn. (USA)). *Phys. Lett., B;* **59**: No. 2, 121-124(27 Oct 1975).

It is pointed out that folding models are not successful in predicting the strength of the real potential near the strong absorption radius which is required by elastic scattering data. (NL)

9963 **On-shell theory of two-step processes.** Mangoli, V.; Robson, D. (Florida State Univ., Tallahassee (USA). Dept. of Physics). *Nucl. Phys., A;* **252**: No. 2, 354-364(10 Nov 1975).

A general and exact distorted-wave theory of multi-step processes is discussed which involves only transition amplitudes to intermediate states which conserve energy. Two-step processes are identified with those terms in the general theory for which the DWBA approximation can be used at each step. Conservation of energy in the intermediate stages allows the post—prior relation to be used and thus makes successive transfer amplitudes for light ions calculable via a zero-range calculation at each stage. This method is applied to the (p,t) reaction leading to the unnatural-parity state (3^+) in the ^{206}Pb nucleus. Interference between intermediate states involving triplet and singlet deuterons is investigated and found to be less than previously predicted. The (p yields d yields t) process is found to be the dominant two-step process for the ^{208}Pb(p,t)^{206}Pb(3^+) reaction at E/sub p/ = 35 MeV. (NL)

9964 **Calculation of the covariant pion-nucleus optical potential. I. Kinematical aspects.** Celenza, L.; Liu, L.C.; Shakin, C.M. (Department of Physics and the Institute of Nuclear Theory, Brooklyn College of the City University of New York, Brooklyn, New York 11210). *Phys. Rev., C;* **12**: No. 6, 1983-1993(Dec 1975).

A discussion of several kinematical schemes used in the study of pion-nucleus scattering is presented. It is shown that various kinematical ambiguities of the noncovariant theories are resolved in a covariant analysis. In particular, the use of an off-mass-shell description for the projectile and the target particles provides a degree of freedom in the kinematical description which avoids various problems present in the noncovariant analyses. A comparison is made of the angle transformations, matrix elements, and differential cross sections obtained from the different kinematical specifications. In these comparisons an attempt has been made to maintain a clear separation of the dynamical and kinematical assumptions, using the same pion-nucleon interaction in the all cases considered. It is found that the large angle scattering is most sensitive to the details of the kinematical description. (AIP)

9965 **Energy-dependent Hamiltonians, charge densities, and recoil effects.** Friar, J.L. (Department of Physics, Brown University, Providence, Rhode Island 02912). *Phys. Rev., C;* **12**: No. 6, 2127-2129(Dec 1975).

Two recent papers are shown to be related, and the unifying ingredient is an energy-dependent Hamiltonian. (AIP)

RADIOACTIVE DECAY

9966 (ORO—4856-26, pp 293-294) **Finite-range distorted wave theory of cluster knock-out reactions.** Park, J.Y. (North Carolina State Univ., Raleigh). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9967 (ORO—4856-26, pp 601-614) **Alpha widths from nuclear models.** Mang, H.J. (Univ., Muenchen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

Methods to calculate alpha widths from nuclear model wavefunctions are reviewed and the underlying assumptions discussed. Comparison of experimental and calculated reduced widths is made. Some new results on absolute values of alpha transition rates are reported. (auth)

SPONTANEOUS AND INDUCED FISSION

9968 (ORO—4856-26, pp 565-585) **Theory of nuclear fission: present status and prospects.** Mosel, U. (Univ., Giessen, Ger.). 1975.

From 2 international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

General properties of nuclear fission are reviewed and related to our present knowledge of fission theory. For this purpose the basic reasons for the shape of the fission barriers are discussed and their consequences compared with experimental results on barrier shapes and structures. Special emphasis is put on the asymmetry of the fission barriers and mass-distributions and its relation to the shells of the nascent fragment clusters. Finally the problem of a dynamical description of fission and its relation to the question of viscosity is discussed. (auth)

9969 (ORO—4856-26, pp 587-588) **Macroscopic—microscopic approach to a cluster-representation of fission.** Schultheis, H.; Schultheis, R.; Wildermuth, K. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The application of cluster representations for calculating shell correction energies relates nuclear deformations to cluster amplitudes. Results are given concerning the minima of potential energy surfaces and the mass asymmetry in fission. (auth)

9970 (ORO—4856-26, pp 595-596) **Rotational instability of superheavy nuclei: a macroscopic—microscopic description.** Mustafa, M.G.; Kan, K. (Univ. of Maryland, College Park). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The instability towards fission of rotating compound nuclei in the superheavy mass region (formed, for example, by heavy ion collisions) is studied. The investigation is carried out by calculating the effective potential energy surfaces and hence the fission barriers of rotating nuclei with a macroscopic—microscopic method. The method takes into account nuclear shell and pairing effects in the effective potential energy as opposed to the macroscopic method of Cohen, Plasil and Swiatecki, who have calculated fission barriers of rotating charged liquid drops. (auth)

9971 **Dynamics and non-adiabaticity in the fission process.** Schuette, G. (Heidelberg Univ. (F.R. Germany). Inst. fuer Theoretische Physik); Wilets, L. (Washington Univ., Seattle (USA). Dept. of Physics). *Nucl. Phys., A;* **252**: No. 1, 21-41(3 Nov 1975).

The fission process takes a time which is not appreciably longer than single-particle times; therefore, it is not clear that the fragmentation process can be described in an adiabatic limit. In this paper the excitation of the nucleus during the deformation process is calculated both analytically and numerically within the framework of the cranking model. The model nucleus is defined by a Hamiltonian containing a deforming Nilsson-type single-particle Hamiltonian, pairing interaction, and schematic residual interaction. For this time-dependent Hamiltonian, the time-dependent Schroedinger equation is solved by (i) perturbation expansion for the analytic discussion and (ii) direct numerical procedure. For the numerical solution, the Hilbert space is confined to the BCS ground state and a limited number of two quasi-particle excitations corresponding to lowest excitation energy. Calculations have been performed for a vibrating calcium and a fissioning uranium nucleus. (NL)

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 9922, 9951

9972 (ORO—4856-26, pp 89-106) **Unified theory of the nucleus.** Wildermuth, K. (Univ., Tuebingen, Ger.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The different phenomena which play a role in low energy nuclear physics, such as reactions and bound state properties of the nuclei, are considered from a unified microscopic point of view. To achieve this the microscopic, many-particle Schroedinger equation is formulated as a projection equation. Consequently basis wave functions can be introduced which describe the nuclear system under consideration in a very flexible way, adjusted to the experimental conditions. This means for instance that the basis wave functions can be chosen in such a way that the incoming and reaction channels are contained in a completely symmetric way in the related coupled-channel equations. The specific experimental situation which one wants to describe is then taken into account by the boundary conditions of the solutions of the coupled-channel equations. One central point of this theory is the influence of the Pauli principle which resolves for instance the seemingly contradictory features of many nuclear phenomena such as e.g., single particle features and collective features. 3 figures. (auth)

9973 (ORO—4856-26, pp 205-219) **Pauli exclusion principle and effective potential interaction of composite particles -on and off the energy shell.** Neudatchin, V.G. (Moscow State Univ.). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

The manifestation of the Pauli principle in the interaction of complex nuclear systems is discussed. 28 references. (BJG)

9974 (ORO—4856-26, pp 225-226) **Odd—even model with Pauli repulsive core for ^{3}H + ^{4}He scattering.** Partridge, R.A.; Brown, R.E.; Tang, Y.C.; Thompson, D.R. (Univ. of Minnesota, Minneapolis). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9975 (ORO—4856-26, pp 297-298) **Three-body model of ^{6}Li and the ^{6}Li --greater than α+d momentum distribution.** Lehman, D.R.; Rai, M.; Ghovanlou, A. (George Washington Univ., Washington, DC). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

9976 (ORO—4856-26, pp 458-459) **Alpha-transfer reactions and the pairing-vibration model.** Betts, R.R. (Niels Bohr Inst., Copenhagen). 1975.

From 2. international conference on clustering phenomena in nuclei; College Park, Maryland, USA (21 Apr 1975).

In Clustering phenomena in nuclei: II.

RADIATION AND SHIELDING PHYSICS

9977 (AEC-tr—7315, pp 52-56) **Attenuation of a collimated slow neutron beam by plane: parallel barriers.** Ponomarev, E.G.; Tyufyakov, N.D.; Shtan, A.S.; Yaskevish, V.S. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

In the nondestructive control of the quality of materials and articles by the neutron radiography method, the sensitivity of appearance of defects and the range of material thicknesses, accessible for control, depends, for the same conditions, on the character of the spreading of the slow neutron beam through the transilluminated object. Such data are necessary for the choice of the neutron source, plotting of the exposure nomogram, determination of the scattered neutron flux, evaluation of the magnitude of the background radiation accompanying the spreading of slow neutrons in the matter, etc. Some of the indicated characteristics, as applied to neutron radiography, can be determined if the transmission coefficients of the collimated neutron beam by the investigated materials are known. These coefficients were determined experimentally in the present work. The measurements were carried out using plane-parallel discs of lead, uranium, tungsten (alloy VNM-2-3), plastic, and steel. The dimensions of the discs were 100 x 100 mm in case of uranium and tungsten, and 300 x 300 mm in case of the other materials. (auth)

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 9563, 9564, 9990, 10037

9978 (ORNL—5046, pp 69-72) **Distribution of energy losses of low-energy protons in hydrocarbon gases.** Thorngate, J.H.; Shinpaugh, W.S. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Calibration and normalization of target and analyzer facilities for the measurement of energy losses of protons (50 to 150 keV) in hydrocarbon gases are described. Data are presented for proton energy losses in molecular hydrogen. 3 figures, 1 table. (GHT)

9979 (ORNL—5046, pp 136-155) **General physics.** Anderson, V.E.; Brandt, W.; Ritchie, R.H.; Ferrell, T.L.; Hamm, R.N.; Ashley, J.C.; Neufeld, J.; Tung, C.J.; Turner, J.E.; Wright, H.A. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics covered include: pion beam dosimetry; estimated W values for negative pions in nitrogen and argon; Monte Carlo treatment of multiple coulomb scattering in pion-beam dose calculations; surface-plasmon excitation in x-ray inelastic scattering on spherical voids in metals; theory of the linear response function of a model insulator; application of the model insulator theory to Al_2O_3, the low-energy end of the electron slowing-down spectrum; scattering of electromagnetic waves by cylinders, excitation of surface-plasmon modes; energy loss of swift proton clusters in solids; a statistical approach to the evaluation of electron inelastic mean free paths in solids; and tabulation of electron interaction parameters in Al and Al_2O_3. 24 figures, 3 tables. (GHT)

9980 (ORNL-TM—5188) **Inelastic interactions of swift electrons in solids.** Tung, C.J.; Ritchie, R.H.; Ashley, J.C.; Anderson, V.E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 120p. Dep. NTIS $7.00.

Thesis. Submitted by C. J. Tung to the Graduate School of the Univ. of Tennessee, Knoxville.

Theoretical calculations of electron mean free paths and electron slowing-down spectra in solids are described. These calculations involve (a) the use of an electron gas model to approximate the response of conduction band electrons in metals, (b) the application of a statistical model for the calculation of electron mean free paths in metals, (c) the development of an insulator model to describe valence band electrons in insulators and semiconductors, and (d) the use of data on atomic generalized oscillator strengths to describe the excitation of the ion cores. Exchange effects are included in the calculations through a semi-empirical procedure. Detailed results are presented for electron mean free paths in Ag, Au, Al, and Al_2O_3, and on the stopping power of Al and Al_2O_3, for electrons with energies at a few eV to 10 keV. The agreement of these calculations with experimental measurements is quite reasonable over a wide range of electron energies. A detailed description of the calculation of electron slowing-down spectra in solids is presented. Low energy electron slowing-down spectra of monoenergetic electron sources in Al and Al_2O_3 are calculated. Calculations of electron slowing-down spectra in Al_2O_3 are made using differential cross sections obtained employing an insulator model and from GOS functions for ion core electrons. Auger electron contributions to the slowing-down spectrum are discussed. Results for the slowing-down spectrum are compared with the experimental data measured by Birkhoff and coworkers. Generally good agreement is found over a wide range of electron energies. (auth)

9981 (UCRL—77202) **Electron beam energy deposition and VUV efficiency measurements in rare gases.** Turner, C.E. Jr.; Hoff, P.W.; Taska, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. 25p. (CONF-751108—18). Dep. NTIS $4.25.

From 1. international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

Reliable techniques for the determination of the energy/cm^3 deposited by an e-beam into a gas as well as the energy/cm^3 radiated have been developed in order to obtain dependable data on the VUV fluorescence efficiency for rare gas excimers. Spatially resolved total stopping calorimetry in the gas at the cell foil was used to characterize the energy distribution in the e-beam (approximately 200 kV, few Amp/cm^2, approximately 1 μsec) transmitted by a "hibachi"-supported 1-mil Ti foil. By using these

data, suitable input for a 3-D Monte Carlo electron transport code (SANDYL) was generated. The spatial distribution of energy deposition in the gas was then calculated taking into account multiple scattering and cell geometry. The validity of the SANDYL technique is substantiated by excellent agreement between the measured and calculated energy flux on a vertical stack of five fast risetime (less than 1 msec) calorimeters at several depth positions [0 less than Z(cm) less than 15] in the gas [1 less than P(atm) less than 3]. Calibrated optical components were used in a well defined geometry that permitted calculation of the effective radiating volume observed. By using the above techniques, high absolute efficiencies (10—30 percent) have been measured for rare gas VUV continua emission which can photolytically produce group VI metastables [e.g., O(^{1}S), S(^{1}S)] of interest as fusion visible-laser candidates.

9982 (AEC-tr—7315, pp 82-87) **Simulation of absorbing media in the use of γ-radiation sources.** Mashinin, V.A.; Popov, A.A.; Schelokov, S.P. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

In radioisotope instrument manufacturing, the finishing stages often require testing with natural media that can be corrosive, inflammable, toxic, or otherwise dangerous to handle. Expressions are derived to enable the simulation of natural media by the combination of three components with known characteristics. The radiation field in the simulator material due to gamma radiation can be made nearly identical to the field in the natural material. (GHT)

9983 **Alpha particle range and x-ray absorption measurements on thin foils.** Carlton, R.F.; Welch, A.H. Jr. (Middle Tennessee State Univ. Murfreesboro,). *J. Tenn. Acad. Sci.;* **48**: No. 4, 137-138(Oct 1973).

Alpha particles from ^{241}Am and x-rays from ^{57}Co have been used in range and absorption studies using thin copper foils. The theory and advantages of the two methods in measuring foil thicknesses are discussed, as well as the data analysis. The photoelectric cross section of copper at a photon energy of 15 keV has been obtained from the analysis of the x-ray data. Such a study, incorporated in an undergraduate laboratory, may serve to elucidate the fundamental difference of the interaction processes involved. (auth)

9984 **Ionization yields in gases under electron irradiation.** Inokuti, M. (Argonne National Lab., IL). *Radiat. Res.;* **64**: No. 1, 6-22(Oct 1975).

The total number N/sub i/(T) of ionizations that an incident electron of kinetic energy T generates in a pure gas at low pressure obeys an integral equation known as the Flower equation. Data show that its solution approximates N/sub i/(T) =(T - U)/W/sub alpha/ for T exceeding many multiples of the first ionization energy I, where U and W/sub alpha/ are constants having the energy dimension. Attempts are made to derive formulas that express U and W/sub alpha/ in terms of various cross sections for electron inelastic collisions with a gas molecule. The paper also describes the background of the problem and includes a critique of underlying assumptions that are often left unmentioned. (auth)

9985 **Energy deposition by electrons and degradation spectra.** Douthat, D.A. (Kennedy-King Coll., Chicago). *Radiat. Res.;* **64**: No. 1, 141-152(Oct 1975).

The energy distribution of particles in an irradiated system, the degradation spectrum, is perhaps the most fundamental piece of information in a description of the radiation field acting on the system. Recent progress in the calculation of electron degradation spectra as well as some systematics of electron degradation spectra are discussed and this method is compared with other viewpoints, e.g., CSDA, Monte Carlo, and Fowler-equation calculations. Deficiencies in the available data as well as prospects for further calculations will also be discussed. (auth)

9986 **Electron slowing-down spectra in solids.** Ritchie, R.H. (Cambridge Univ., Eng.); Tung, C.J.; Anderson, V.E.; Ashley, J.C. *Radiat. Res.;* **64**: No. 1, 181-204(Oct 1975).

Some theoretical methods used to describe the interaction of electrons with metals, semiconductors, and insulators are reviewed. Calculations of electron slowing-down spectra using these methods are presented for Al, Cu, Cr, Si, and Al_2O_3. Experimental electron slowing-down spectra for these materials are also presented and comparisons with theoretical calculations are discussed. 40 refs. (auth)

9987 (LA-tr—75-33) **Coherent phenomena in the interaction of Moessbauer radiation with crystals (progress in theory).** Kagan, Yu.M. Nov 1975. Translation by H. Dahlby of Polish report. (CONF-750815—2). 32p. Dep. NTIS $5.00.

From International conference on mossbauer spectroscopy; Cracow, Poland (Aug 1975).

Attention is focused on the analysis of results previously obtained in the theory of the coherent phenomena accompanying resonance interaction of Moessbauer radiation with crystals. Specific sections include: stimulated radiation of gamma-quanta in a crystal under conditions of Bragg scattering, suppression of the broadening of a Moessbauer line caused by non-uniform isomer shift, and suppression of a non-uniform isomer shift under conditions of resonant optical repopulation of the electronic levels. (GHT)

9988 **Platzman's analysis of the delivery of radiation energy to molecules.** Fano, U. (Univ. of Chicago). *Radiat. Res.;* **64**: No. 2, 217-232(Nov 1975).

Robert L. Platzman strove for a quarter of a century to develop a quantitative picture of the delivery of energy to individual molecules by ionizing radiations—a prerequisite to the understanding of further stages of radiation action. Comprehensive results of these efforts, achieved shortly after his untimely death by several of his collaborators and students, are reviewed in this article, with emphasis on the methods that led to them. Characteristic of the methods is the skillful use of fragmentary data, resting on clear theoretical understanding and on critical knowledge of vast experimental evidence. The program involved a persistent, successful quest for whatever new experimental information seemed essential to basic understanding. The article points to the opportunity for systematic extension of the new results, thus far confined to pilot examples, as well as to the next major stage of inquiry into fundamental mechanisms. 9 figures, 53 references. (auth)

SHIELDING CALCULATIONS AND EXPERIMENTS

REFER ALSO TO CITATION(S) 9186, 9982

9989 (AEC-tr—7315, pp 13-22) **Radiation shielding of energy generators based on β- and γ-emitting isotopes.** Zharkov, V.A.; Rodionov, Yu.A.; Filatov, L.A. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

Some problems of the radiation shielding of generators with isotope blocks, based on β-emitters accompanied with γ or bremsstrahlung radiation (^{60}Co, ^{137}Cs, ^{90}Sr, etc.), are investigated. Calculations of shielding to optimize both weight and dimensions of the final shield are given. 3 figs., 1 table. (GHT)

9990 (AEC-tr—7315, pp 88-100) **Problem of the form of the curve of attenuation of a β-radiation flux in matter.** Kukharenko, I.V.; Mashinin, V.A.; Salakhov, A.M.; Shipulina, L.A. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

An expression is derived which enables calculation of the multiplicity of attenuation of a flux of β-particles that has passed through an absorber. Comparison of calculated values and experimental values is made. 7 figs, 3 tables (GHT)

9991 **Cross-section uncertainty analysis.** Muir, D.W. (Los Alamos Scientific Lab., NM); Harris, D.R.; Foster, D.G. Jr.; MacFarlane, R.E.; Reupke, W.A.; Wilson, W.B. *Trans. Am. Nucl. Soc.;* **22**: 794-795(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

MEDICAL PHYSICS

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

9992 **ENGINEERING COMPENDIUM ON RADIATION SHIELDING. VOLUME II. SHIELDING MATERIALS.** Jaeger, R.G. (ed.). New York; United States of America (USA); Springer-Verlag New York Inc. (1975). 447p. $137.60.

Properties of shielding materials for gamma radiation, including occurrence and extraction, physical properties, fabrication, and applications and design considerations are presented for lead and lead alloys, iron and iron alloys (steel), uranium, tungsten, bismuth, copper, aluminum, soil, ceramics, water, transparent materials (silicate and lead glasses), concretes, and air. Neutron shielding properties are given for lead and lead alloys, iron and iron alloys, uranium, tungsten, bismuth, copper, aluminum, beryllium, graphite, water, organic materials (rubber, plastics, oils, paraffins), wood and compressed wood, metallic and saline hydrides, cadmium and cadmium alloys, boron and boron compounds, boral, boron-graphite, combinations, concretes, and air. Laminated

shields are discussed, the effects of heating on the properties of concretes are given, and optimization of the choice of shielding materials is considered. Extensive tables and figures. (GHT)

9993 (ORNL-TM—5176) **Survey of shielding sensitivity analysis development and applications program at ORNL.** Oblow, E.M. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 53p. (CONF-751063—2). AT.

From Specialists[7] meeting on sensitivity studies and shielding benchmarks; Paris, France (7 Oct 1975).

The cross-section sensitivity analysis program at ORNL is reviewed with emphasis on present computer code capabilities and past successful applications in the radiation shielding area. The FORSS sensitivity code system is discussed in regard to objectives, methodology, and code specifications. Examples of past shielding applications of FORSS emphasize the success of fine energy grid sensitivity studies and group structure selection, the use of evaluated error files in problem uncertainty estimation, two-dimensional shield sensitivity analysis and integral experiment design for fast reactors, data studies for the LMFBR program related to sodium and iron evaluations, and iron data problems in CTR shield design. Conclusions are drawn about the adequacy of present ENDF/B data files for sodium and iron and the general applicability of sensitivity studies in future shield design and analysis. (auth)

9994 (AEC-tr—7315, pp 48-51) **Measurement of the spectro-angular characteristics of the β-sources BIS-10.** Kumirov, A.L.; Terent'ev, B.M. 1971. Translated from Radiats. Tekh.; No. 6, (1971).

In Radiation Technology, Issue 6.

The results of measurements of the spectro-angular and other characteristics of the sources BIS-10 of 1-10m Curie activity are presented. Comparison is made to the measured spectrum of a thin ^{90}Sr-^{90}Y source. 2 figures. (GHT)

9995 **Beta emission from encapsulated sources of ^{252}Cf.** Dicello, J.F.; Colvett, R.D.; Gross, W.; Kraljevic, U. (Columbia Univ., New York). *Radiat. Res.*; **64**: No. 2, 401-404(Nov 1975).

Microdosimetric data show that the dose rate in free air for 0.85-μg afterloading cells of californium-252 with 0.25-mm-thick walls of a platinum-iridium alloy is approximately 40 percent higher than for 10-μg applicator tubes with 0.70-mm walls of the same alloy. Although the high LET component of the radiation is in substantial agreement with previous works, the low LET component is approximately twice as large as any previously reported value. Measurements show that the larger dose rate is a result of a substantial amount of beta ray emission which is more strongly absorbed by the thicker walls of the 10-μg applicator tubes.

DOSIMETRY

REFER ALSO TO CITATION(S) 9979, 9995

9996 (ORNL—5046, pp 79-92) **Dosimetry for human exposures.** Auxier, J.A.; Haywood, F.F.; Jones, T.D.; Warner, G.G.; Cheka, J.S.; Kerr, G.D.; Solomon, D.L.; Yamada, H. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics covered include: liaison dosimetry studies with the Atomic Bomb Casualty Commission; in vivo dose estimates for atomic bomb survivors; radiation exposure to atomic bomb survivors residing in the United States; and transmission of photons through common shielding media. (GHT)

9997 (ORNL—5046, pp 207-213) **Variation of the absorbed fraction with shape and size of the thyroid.** Ford, M.R.; Snyder, W.S.; Warner, G.G. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Calculated values for absorbed dose to the thyroid are presented based on nine different mathematical models representing possible shapes for the organ. 7 figures, 2 tables. (GHT)

9998 (ORNL—5046, pp 214-218) **Dose to the bladder.** Snyder, W.S.; Ford, M.R. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Radiation dose to the bladder is calculated based on mathematical models of the bladder for several volumes. Topics covered include: the bladder model; activity in the bladder; dose from photons; results for photon dose; and surface dose from electrons and beta particles. 2 figs, 1 table (GHT)

9999 (ORNL—5046, pp 233) **Absorbed dose during breast x-ray therapy.** Warner, G.G.; Poston, J.W. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

10000 (ORNL—5046, pp 234-238) **Effect of source organ size on absorbed fraction distribution.** Mei, N.H.; Warner, G.G.; Stansbury, P.S.; Poston, J.W. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

A program of measurements was performed to determine if the size of a source organ affected the absorbed fraction in various target organs. Some results from measurements in a phantom are shown compared with calculated values. 5 figs, 2 tables (GHT)

10001 (ORNL—5046, pp 247-248) **Variation of calculated organ dose rates from a pacemaker as a function of body size.** Snyder, W.S.; Warner, G.G. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

The study was undertaken to estimate the dependence of neutron doses to various organs from nuclear powered cardiac pacemakers on the physical size of the individual user. 1 table (GHT)

10002 (ORNL—5046, pp 249-252) **Age factors for dose rates from an infinite cloud of a photon emitter.** Poston, J.W.; Snyder, W.S.; Warner, G.G. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

The dose rates to children, or persons of smaller body size, are considered to see whether the dose estimates for the cloud are reasonably valid for the population as a whole. 4 figures, 2 tables. (GHT)

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 8971, 9987, 10022, 10226

10003 (ITP—75-28R) **Application of phenomenologic approach to an investigation of the induced gyroanisotropic phenomena in dielectrics.** Kharkyanen, V.N.; Petrov, E.G. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 27p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The paper presents a group-theoretical method of obtaining the contribution in tensor of transverse dielectrical permeability of magnetic and nonmagnetic dielectrics from specific transitions forbidden in zero approximation in some axial perturbation. The axial perturbation mentioned above permits the transitions and changes the optical symmetry of a crystal in the frequencies of specific transitions depending upon the type of the transition. The external electric and magnetic fields can be chosen as the axial perturbation. This allows one to change the optical symmetry of a crystal in the vicinity of the given transition. (auth)

10004 (ITP—75-40R) **Spin-phonon interaction in antiferromagnetics.** Grigorashchuk, I.M.; Nitsovich, V.M.; Tovstyuk, K.D. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 8p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The vibrational spectrum and the sound velocity in antiferromagnetics are obtained in the general form in pseudoharmonic approximation with allowance for the anharmonisms of all orders. Starting from experimentally defined dependence of the Debye-Waller factor on the temperature a corollary is put forward that in some antiferromagnetics under the temperature lower than T/subN/ the appearance of the narrow band of paramagnetic states is possible. In antiferromagnetics where the transition metal-dielectric described by the Habbard model is possible this results in the appearance of the additional transition dielectric-metal-dielectric. (auth)

10005 (ITP—75-59R) **Some class of pseudopotentials constructed on the basis of completely orthogonalized plane waves.** Gurskii, B.A.; Gurskii, Z.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 21p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The orthogonalized plane wave basis used in the theory of pseudopotentials is overcomplete and nonorthonormal. In this paper a detailed analysis of the C.O.P.W. basis (completely orthogonalized plane waves) free from these defects is done. The pseudopotential Wcopw is obtained by means of the COPW formalism. In a special case we obtain as various approximations the formerly known pseudopotentials. The relations between two classes of pseudopotentials, Wcopw and Wopw, are discussed.

10006 (ITP—75-66R) **Quantum theory of exciton migration in crystals.** Gaididei, Yu.B.; Serikov, A.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 31p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A study is made of the migration processes of electron excitations in a crystal for a case of wide exciton zones. The time evolution of the electron excitations interacting with the oscillations in a crystal lattice is studied. The problems of motion and diffusion of exciton packets are elucidated. (auth)

10007 (ITP—75-71R) **Effect of external constant magnetic fields on two-magnon light absorption in antiferromagnetics.** Sukhorskaya, N.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 24p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The dependence of the intensity and the shape of two-magnon absorption line (with the magnon-magnon interaction taken into account) on the value and the direction of the electric component intensity of incident light and the external constant magnetic field is investigated. It is shown that for the sufficiently strong fields the appearance of the additional peak and the intensity splash is possible under the general tendency towards the absorption decreasing with the increase of the constant magnon field intensity.

10008 (UCID—16972) **Theoretical consideration of possible nonlinearities in the optical Faraday effect for pulsed high magnetic fields.** Vernon, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Dec 1975. 26p. Dep. NTIS $4.00.

The possible nonlinearities in the optical Faraday effect in insulating materials when used for measuring pulsed magnetic fields at very high flux density is discussed. Possible sources considered are direct high-field nonlinearity, magnetic breakdown, electrooptic effects from the accompanying electric field, magnetostriction and electrostriction, the Voigt effect from field inhomogeneity or misalignment, delay in response to the magnetic pulse, and shock-induced luminescence. Diamagnetic glasses and fused quartz are used for the measurements. 3 figures, 3 tables (auth)

10009 Onset criteria for insulating electronic transitions in three-dimensional systems. Brandow, B.H. (Los Alamos Scientific Lab., NM). *J. Phys., C (London);* **8**: L357-L359(1975).

Contrary to a recent letter in this journal, insulating states of the Peierls or Slater types are found to be impossible in actual three-dimensional systems unless the relevant interaction strength (electron—phonon coupling, or U) exceeds some finite threshold value. There are several distinct effects which contribute to this result. (auth)

10010 Coherence in electronically excited dimers. II. Theory and its relationship to exciton dynamics. Zewail, A.H.; Harris, C.B. (Univ. of California, Berkeley). *Phys. Rev., B;* **11**: No. 2, 935-951(15 Jan 1975).

A theory of microwave absorption in coherent or incoherent states of multidimensional crystals is developed. Application of the theory to the cluster states (dimer, trimer, tetramer,..., etc) of linear chain systems and its relationship to microwave band-to-band transitions in coherent Frenkel excitons provides a new way of studying coherence in the excited levels of molecular solids. A quantitative treatment of the influence of exciton-phonon coupling of spin dynamics in a two-level system (dimer) and the extension to a multilevel system (exciton) is given. The results show that zero-field electron spin resonance can directly measure the cross section of the scattering processes in the excited state and that the technique is applicable to other classes of solids. Moreover, the anisotropy and the magnitude of intermolecular interactions can be established from these experiments. (auth)

10011 Coherence in electronically excited dimers. III. The observation of coherence in dimers using optically detected electron spin resonance in zero field and its relationship to coherence in one-dimensional excitons. Zewail, A.H.; Harris, C.B. (Univ. of California, Berkeley). *Phys. Rev., B;* **11**: No. 2, 952-963(15 Jan 1975).

The observation of coherent dimers in their excited triplet state is reported for a molecular crystal of 1,2,4,5-tetrachlorobenzene at low temperatures (below 4.2 K). Utilizing the theory developed in a previous paper, the coherence time (10^{-6} sec) and the anisotropy of the resonance interactions in the excited state were established. The identification of the dimer as translationally equivalent, from the zero-field optically detected magnetic-resonance spectra, establishes the effective dispersion for the triplet exciton band of the neat crystal. Moreover, the magnitude of the resonance transfer time was shown to be much less than the coherence time: the dimer is coherent for a period of 10^5 times that associated with the stochastic limit. (auth)

10012 Macroscopic engineering properties of polycrystalline materials: elastic properties. Gubernatis, J.E.; Krumhansl, J.A. (Cornell Univ., Ithaca, NY). *J. Appl. Phys.;* **46**: No. 5, 1875-1883(May 1975).

The formal application of integral equation methods (Green's function techniques) to the systematic computation of the effective elastic properties of polycrystalline materials from the specification of the statistical distribution of elastic properties of the constituent grains (or pores) is outlined. These methods are not entirely new, but by the use of recent developments in theory of the physics of the electronic properties and lattice dynamics of disordered solids, we can place various methods on a common footing and indicate their limitations. Some details for the computational application of these methods are also presented.

10013 Piezoelectric current from shunted and shorted guard-ring quartz gauges. Graham, R.A. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.;* **46**: No. 5, 1901-1909(May 1975).

Current from quartz disks in guard-ring configurations is widely used to sense stress pulse profiles resulting from impact or explosive loading. Normally, the guard ring is loaded with a low-impedance resistive shunt selected to maintain voltage balance between electrodes. A similar configuration in which the guard ring is electrically shorted to the ground electrode with a vapor-plated metallic conductor along the periphery of the disk has also been used to sense stress pulses. An experimental investigation of the current pulses produced when these shorted guard-ring quartz gauges are subjected to impact loading has been conducted to compare the responses of shorted and shunted guard-ring quartz gauges. Gauge configurations with guard-ring widths which vary from 0.5 to 3.0 times the thickness of the disk were investigated. It is found that, unlike the behavior of the shunted gauges, shorted gauges do not exhibit a universal response characteristic, i.e., each shorted gauge configuration has a different response to impact loading. Furthermore, the input stresses at which shock-induced conductivity affects the current pulses is found to be lower for shorted gauges than for the shunted gauges and to depend upon the specific shorted gauge configuration. The effects of the width of the insulating gap which separates the guard-ring electrode from the inner electrode are shown to be detectable. Physical mechanisms responsible for the observed differences between the shunted and shorted guard-ring gauges are identified. (auth)

10014 Film-asymmetry effects in resonant photoexcitation of plasmons. Feibelman, P.J. (Sandia Labs., Albuquerque, NM). *Phys. Rev. Lett.;* **35**: No. 9, 617-620(1 Sep 1975).

The spacings and strengths of plasmon resonances in the optical properties of thin films depend on film symmetry, i.e., on whether the film surfaces are identical or not. Taking account of film asymmetry, the reinterpretation of photoyield data of Anderegg, Feuerbacher, and Fitton explains the fairly systematic alternation of their plasmon-associated resonance strengths and implies that their best-fit values of film thicknesses were about twice too large. (auth)

10015 Observation of a spin-Peierls transition in a Heisenberg antiferromagnetic linear-chain system. Bray, J.W. (General Electric Co., Schenectady, NY); Hart, H.R. Jr.; Interrante, L.V.; Jacobs, I.S.; Kasper, J.S.; Watkins, G.D.; Wee, S.H.; Bonner, J.C. *Phys. Rev. Lett.;* **35**: No. 11, 744-747(15 Sep 1975).

Magnetic-susceptibility and EPR measurements are reported which provide the first unambiguous evidence for a spin-Peierls transition in a system of linear one-dimensional antiferromagnetic Heisenberg chains. The material studied is $TTFCuS_4C_4(CF_3)_4$ (TTF stands for tetrathiafulvalinium). At 12 K, the spin-lattice system undergoes a second-order phase transition to a singlet ground state. (auth)

10016 Self-consistent pseudopotential calculation for a metal-semiconductor interface. Louie, S.G.; Cohen, M.L. (Univ. of California, Berkeley). *Phys. Rev. Lett.;* **35**: No. 13, 866-869(29 Sep 1975).

The electronic structure of a jellium-Si interface is calculated with use of a jellium density corresponding to Al and self-consistent Si pseudopotentials. Local densities of states and charge densities are used to study states near the interface. The states which exist in the Si fundamental gap are bulklike in jellium and decay into Si with high concentration in the dangling-bond free-surface-like Si state. The calculated barrier height is in excellent agreement with experiment.

10017 Theory of paramagnetic singlet-doublet excitations in double-hexagonal close-packed praseodymium. Bak, P. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B;* **12**: No. 11, 5203-5212(1 Dec 1975).

The magnetic excitation spectrum of the singlet-doublet magnet double-hexagonal close-packed praseodymium, which has been measured by means of inelastic neutron scattering, is analyzed using a diagrammatic high-density expansion technique. The lowest-order random-phase-approximation diagrams give a detailed description of the wave-vector and temperature depen-

dence of the four modes in terms of a Hamiltonian including isotropic Heisenberg interatomic exchange interactions and anisotropic, dipolar-like exchange interactions. In general, the modes are linearly or elliptically polarized. The leading contributions to the line shapes of the excitations are obtained by extending the 1/Z expansion of the generalized susceptibility propagators one order beyond the random-phase approximation. This damping corresponds to spin-wave scattering on single-site fluctuations. The propagators are calculated self-consistently by including internally renormalized Green's functions. The theoretical spectral functions are in detailed agreement with experiment. (AIP)

10018 Calculation of cooling of ^{3}He by adiabatic demagnetization of a paramagnetic salt. Roach, P.D. (Argonne National Lab., IL); Abraham, B.M.; Roach, P.R.; Ketterson, J.B. *J. Low Temp. Phys.*; **22**: No. 3/4, 301-311(Feb 1976).

In an effort to better understand the various factors involved in refrigeration by adiabatic demagnetization, we have set up a computer model of a paramagnetic salt in contact with liquid ^{3}He. This model has been used to study the cooling of the ^{3}He from an initial temperature of 20 mK, which is typical of the temperature achieved in a dilution refrigerator. The effects of various demagnetization schedules, heat leaks, and varying ratios of salt to liquid have been studied. The model was used to simulate an actual demagnetization and gave excellent agreement with measured temperatures. It is also shown how the model can be extended to the case of nuclear demagnetization. 4 figures. (auth)

SUPERCONDUCTIVITY

REFER ALSO TO CITATION(S) 8985

GENERAL THEORY

REFER ALSO TO CITATION(S) 8990

10019 (CALT—822-77) **Superconductivity in tight-binding approximation.** Poon, S.J. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Oct 1975. Contract AT(04-3)-822. 12p. Dep. NTIS $3.50.

An interpretation of Barisic's relation for transition elements between the d-electron contribution to the cohesive energy and the local atomic parameter eta is presented. This relation is extended to a lattice with more than one atom per unit cell in the tight- binding approximation of rigid ions. It is conjectured that Barisic's relation is correct to first order approximation for transition metal alloys, provided the phonon induced d-d coupling is the dominant mechanism for superconductivity. (auth)

10020 (BNL-tr—619) **Theory of superconducting tapes.** Hlasnik, I. 1975. Translated by S.J. Amoretty from Czech report. (CONF-750950—2). 23p. Dep. NTIS $4.50.

From Conference on technical applications of superconductivity; Alushta, USSR (16 Sep 1975).

Attention has been focused recently on superconducting tape conductors because of the possibility of using them in flexible superconducting ac and dc cables and because of the development of the technology of fabricating multifilament tape superconductors for superconducting magnets. A presentation is given of some of the results obtained in studying the effect of the geometry of such conductors on the current distribution and losses occurring in them and on the magnitude and anisotropy of their critical current. Using functions of a complex variable, the current distribution is examined in a straight section of a tape under conditions of partial penetration of the transport current. It is shown that additional ac current losses occur in the tape due to a nonuniform distribution of the current. The distribution of the magnetic field and current in a round single-layer cable with tightly wound superconducting tapes in the presence of a transport current is then analyzed. Use is made of the equations for the critical current and for the additional current losses occurring in this cable when ac current is applied, as a function of the angle of inclination of the helically wound tapes. Finally, the effect of inclination of the oblate helically wound tapes of the multifilament superconductor on the critical current and its dependence on the direction of the magnetic induction vector anti B relative to the conductor's plane are examined. 8 figures. (auth)

10021 (BNL-tr—616) **Theory of multifilamentary superconducting tapes.** Hlasnik, I. Translated by S.J. Amoretty from *Elektrotech. Cas.*; **26**: No. 4, 259-270(1975). 21p. Dep. NTIS $4.50.

Eddy currents in a conventional metal are calculated for a multifilament superconducting tape in a variable magnetic field with anti B perpendicular to the plane of the tape. On this basis, additional losses due to these currents are calculated and compared with the losses in the superconductor. The conditions under which the results are valid were determined and compared with analogous results obtained by using a simplified Smith model for multifilament superconducting wires. 5 figures. (auth)

10022 Possible relationship between dynamic instability of a lattice and superconductivity in semiconductors. Kristofel, N.N. (Institute of Physics, Academy of Sciences of the Estonian SSR, Tartu). *Sov. Phys. - Solid State (Engl. Transl.)*; **17**: No. 5, 909-910(May 1975).

It is shown that in the presence of a soft transverse optical vibration mode, responsible for the Umklapp processes in a many-valley polar semiconductor, (subject to certain approximations) an anomalous increase is expected in the electron-electron attraction constant on approach to the structure transition point. This may give rise to superconductivity. An estimate is obtained of the difference between the superconducting and structure transition temperatures. (AIP)

10023 Effect of magnetic impurities on fluctuations in superconducting films above T/subc/. Entin-Wohlman, O.; Orbach, R. (Department of Physics and Astronomy, Tel-Aviv University, Tel-Aviv, Israel). *Phys. Rev., B;* **12**: No. 11, 4812-4815(1 Dec 1975).

The effect of magnetic impurities on the excess tunneling current, caused by fluctuations in a Josephson junction is calculated. The two metals on opposite sides of the junction have different transition temperatures. At temperatures immediately above the transition temperature T/subc/ of the low-T/subc/ side, the excess current versus voltage is found to have a quasi-Lorentzian shape, exactly as in the absence of pair-breaking mechanisms. However, the pair relaxation frequency is reduced by the pair-breaking mechanism, and the coherence length is enhanced. This causes a detectable diminution in the peak voltage, which can serve as a direct measure of the pair-breaking strength. It is suggested that this effect could be used to probe the critical scattering of conduction-electron spins in the vicinity of the magnetic-ordering temperature. (AIP)

10024 Phenomenological approach to high-transition-temperature superconducting alloys. Poon, S.J.; Johnson, W.L. (W. M. Keck Laborabory of Engineering Materials, California Institute of Technology, Pasadena, California 91125). *Phys. Rev., B;* **12**: No. 11, 4816-4824(1 Dec 1975).

Correlations between the observed maximum superconducting transition temperature T/subc/ for a given binary alloy system and the alloy melting temperature T/subm/ are pointed out. The stability of alloy phases favorable for high-temperature superconductivity is discussed in terms of alloy phase diagrams. A comparison with the microscopic theory shows that the correlation between T/subc/ and T/subm/ can be interpreted in terms of the d-electron contribution to the cohesive energy of transition-metal alloys as proposed by Barisic, Labbe, and Friedel. The prospects for obtaining high T/subc/'s are discussed in view of these results, and new alloy systems are suggested. (AIP)

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 8922, 8923, 8924, 8925, 8970, 8979, 8980, 8981, 8983, 8984, 8986, 8987, 8988, 8989, 8991, 8993, 8994, 8999, 9001, 9002, 9004, 9005, 9006, 9018, 9019, 9049, 9078, 9576

10025 (FRNC-TH—583) **Mathematical model for a mercury-rare gas (Ar,Ne) discharge excited at low pressure and low frequency range (0-20 kHz).** Dimitriadis, A. (Toulouse-3 Univ., 31 (France)). 1975. vp. (In French). INIS.

The properties of the positive column of low pressure mercury-rare gas (Ar,Ne) discharges was studied in the 0-20 kHz frequency range. A calculation of the fundamental parameters of these discharges was made using a model which is based on a five-level energy scheme of the mercury atom. The validity of the model was tested by comparing the results with the experimental values already existing in the literature. (FR)

10026 (IS-M—51) **Single crystal elastic constants with inferences pertinent to vibrational behavior and superconductivity.** Smith, J.F. (Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1975. 12p. (CONF-751212—1). Dep. NTIS $4.50.

From International conference on low lying lattice vibrational models and their relationship to superconductivity and ferroelectricity; San Juan, Puerto Rico (1 Dec 1975).

Data are presented to show that indications of mode softening may be obtained from elasticity measurements. In the extreme limit where mode softening results in the vanishing of an elastic constant, phase instability ensues. Mode softening and supercon-

ductivity are interrelated, and unusual elastic behavior is often observed in superconductors. Such elastic behavior and superconductivity seem to arise from a common cause. 1 table. (auth)

10027 Magnetization and design of multistrand superconducting conductors. Walters, C.R. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 328-331(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

Magnetization of cabled and braided samples which are long compared to their transposition lengths has been measured in a uniform magnetizing field directed at right angles to their widths. A separated double pancake with nonuniform windings was constructed to produce a suitably uniform radial field in which long coiled samples could be placed. Magnetization losses have also been measured in the ISA I magnet at BNL. Results are compared with theories which are due to Wilson and, basically, Morgan. Also, design optimization procedures have been defined for the use of multistrand conductors in magnet windings. 7 figures, 3 tables. (auth)

10028 Magnetic field microprobe in superconductors carrying a current. Migliori, A.; Bartlett, R.J.; Taylor, R.D. (Los Alamos Scientific Lab., NM). *IEEE Trans. Magn.;* **MAG-11**: No. 2, 347-349(Mar 1975).

From Applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

See CONF-740957—.

A new technique to probe local magnetic fields inside superconductors utilizing the Moessbauer Effect (ME) is reported. The ME nucleus responds to the local magnetic field resulting in a modified hyperfine ME spectrum from which the local field and its direction may be deduced. Concentrations of a few ppm of the radioactive probe nucleus are sufficient; the allowable depth of the probe depends on the attenuation of the ME γ ray. For ^{57}Fe (^{57}Co parent) in superconductors the field acts directly on the nuclear moment and the resulting sensitivity is only a few kG. For a thin probe consisting of ^{57}Co in Pd the response is enhanced by the "giant" localized moment providing a sensitivity at 1 K of better than 100 G. Results of such a probe placed at various locations across a commercial Nb_3Sn tape carrying a current are reported and compared with calculations of the field profile using several models. For thin tape geometries the usual models prove to be inadequate. 4 figures. (auth)

10029 Equal area property of narrow resonances induced in coupled Doppler-broadened systems by intense laser radiation. Feldman, B.J. (Los Alamos Scientific Lab., NM); Feld, M.S. *Phys. Rev., A;* **12**: No. 3, 1013-1018(Sep 1975).

It is well known that the spectral line shape of the narrow change signal induced at one Doppler-broadened transition by an intense laser field resonating with a second one can be extremely complex and nonclassical in form, the exact details depending on such factors as the direction of observation relative to the propagation direction of the laser field and its spatial form (traveling wave or standing wave). Nevertheless, the area under the change signal line shape, i.e. its frequency-integrated intensity, is always the same for a given laser field, and is independent of the coupling between laser and change-signal fields. A proof of this equal area property, based on quantum-mechanical transition-rate theory, is given for a three-level system composed of degenerate or near-degenerate states. The resulting expression is also applicable to line-shape calculations for experiments which study resonance fluorescence induced by intense laser or resonance radiation or other forms of excitation. (auth)

THEORETICAL PHYSICS

GENERAL AND MISCELLANEOUS

10030 (BNWL-SA—5582) **Mathematical foundation workshop V-statistics of measurement.** Nicholson, W.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 3p. (CONF-750986—1). Dep. NTIS $4.50.

From 4. international congress of the Society for Stereology; Washington, District of Columbia, USA (4 Sep 1975).

The discussion of the statistics of measurement includes the required number of measurements and the precision of the estimate. Basic stereological relations describe global or average value geometric properties of the three-dimensional structure. Actual measurements are distributed about such a global property. The precision of such a global property estimate depends upon the method of taking measurements and the complexity of the structure as well as the number of measurements. If the structure is spatially heterogeneous, precision is highly dependent on the sampling plan used to select the sections for examination. (JFP)

10031 Multipoles in cylindrical coordinates. McMillan, E.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Instrum. Methods;* **127**: No. 3, 471-474(15 Aug 1975).

Solutions of Laplace's equation for azimuthally symmetrical potentials in cylindrical coordinates are found which can be correlated with two-dimensional multipoles in planes theta = const. Formulas are presented by which the coefficients for linear combinations of these solutions can be calculated to describe fields whose values are known along given axial or radial lines. (NL)

10032 Fourier transform infrared spectroscopy. Bates, J.B. (Oak Ridge National Lab., TN). *Science;* **191**: No. 4222, 31-37(9 Jan 1976).

A background in the principles of FT IR spectroscopy is given and possible applications of this technique are discussed. A short discussion of Fourier series is presented as an aid to understanding how FT spectroscopy works. Results are stated without proof, and only the most essential concepts are discussed. Some details which are important but are not essential for a basic understanding of FT IR are discussed at the end of the article. A section on applications includes examples from recently published articles which illustrate some of the unique features of FT IR spectroscopy. (auth)

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 9711, 10029

10033 Quantum expansion of soliton solutions. Christ, N.H.; Lee, T.D. (Columbia University, New York, New York 10027). *Phys. Rev., D;* **12**: No. 6, 1606-1627(15 Sep 1975).

A systematic quantum expansion of soliton solutions to nonlinear field equations is developed. The method is based on the standard canonical quantization procedure. When the nonlinear coupling g is small, the Hamiltonian is $O(g^{-2})$ and its quantum eigenstates take on a WKB form, giving a direct connection between the quantum description and the corresponding classical soliton solution (which can be in any dimension, either time-dependent or time-independent). Our general method is illustrated by a variety of one-space-dimensional examples, some new and some old. (AIP)

10034 Does God play dice. A discussion of some interpretations of quantum mechanics. Ross-Bonney, A.A. (Univ. of California, Berkeley). *Nuovo Cim., B;* **30B**: No. 1, 55-79(11 Nov 1975).

Three interpretations of quantum mechanics are reexamined: the orthodox or "Copenhagen" interpretation, the expanding worlds interpretation and the interpretation that is generally named statistical. It is concluded that the first two interpretations introduce unnecessary conceptual difficulties, and that it is consequently preferable to accept the statistical interpretation. (auth)

RELATIVITY AND GRAVITATION

10035 Ward identities in gauge theories of gravitation with higher derivatives. Gavrielides, A.; Kuo, T.K.; Lee, S.Y. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Phys. Rev., D;* **12**: No. 6, 1829-1831(15 Sep 1975).

The quantization of gauge theories of gravitation with k^{-4} propagator is investigated with the functional integration method. It is found that gauge-fixing terms in these theories are quite different from those in ordinary gauge theories. Ward identities are then derived and used to show that there is no renormalization of the longitudinal parts of the two-point Green's functions, just as expected. It is also shown that in order to satisfy these identities the bare graviton propagator has to come from the term of the square of the Riemann curvature tensor in the Lagrangian. (AIP)

OPTICS

REFER ALSO TO CITATION(S) 9562

10036 (LBL—4179) **Some fundamental aspects of nonlinear optics.** Shen, Y.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-Eng-48. 64p. (CONF-7506104—3). Dep. NTIS $4.50.

From Proceedings on nonlinear optical spectroscopy; Varenna, Italy (30 Jun 1975).

Selected topics related to the fundamentals of nonlinear optics are discussed. First, a brief description on the theory of nonlinear optical susceptibilities is given. Emphasis is on the basic properties, on the recently developed bond theory, and on the disper-

sion of nonlinear susceptibilities. Then the coupled wave approach is discussed. It is shown that the transverse resonant excitation in material can be treated as a material excitational wave, and most nonlinear optics problems can be understood as results of coupling between em waves or em and material excitational waves. A number of examples of current interest are presented. These include sum- and difference-frequency generation, Raman scattering by coherent excitation, stimulated Raman and stimulated polariton scattering, four-wave mixing, and vibrational relaxation measurements. Finally, the physical distinction between laser emission and resonant stimulated Raman scattering in an optically pumped three-level system are considered. A similar problem on the distinction of hot luminescence and resonant Raman scattering has recently attracted much attention. It is shown that the hot laser action is connected directly with the population inversion, while the resonant stimulated Raman scattering is connected with transverse excitation. The problem is, however, more complicated for a multilevel system. (auth)

10037 (ORNL—5046, pp 120-135) **Physics of solids and macromolecules.** Arakawa, E.T.; Birkhoff, R.D.; Braundmeier, A.J.; Callcott, T.A.; Cox, J.T.; Hamm, R.N.; Inagaki, T.; Juan, S.I.; Wheeler, C.E.; Williams, M.W. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics covered include: optical properties of solid sodium and lithium from ellipsometric measurements; coupling of photons and surface plasmons at interfaces of known profile; photoemission from aluminum; electron attenuation lengths in carbon films; optical and dielectric properties of bovine plasma albumin between 2 and 82 eV; optical and dielectric properties of polystyrene between 2 and 82 eV; feasibility studies of monitoring the first wall in ORMAK by optical measurements; and soft x-ray emission from insulators. 18 figures. (GHT)

10038 Fabry—Perot interferograms of periodic spectra of molecules with large rotational constants. Hargis, P.J.; Hill, R.A. (Sandia Labs., Albuquerque, NM). *J. Opt. Soc. Am.;* **65**: No. 2, 219-220(Feb 1975).

The effect of the magnitude of the molecular constant B on the appearance of multiplexed spectra is examined. (CES)

10039 Conical axicons used as optical polar everters. Lavoie, L. (Univ. of Chicago). *Appl. Opt.;* **14**: No. 7, 1482-1484(Jul 1975).

Some design equations for conical axicons used as polar everting (radially inverting) prisms are given. Three possibilities are described, one which causes polar eversion and 180° rotation of the field and two which cause polar eversion without field rotation. The treatment is for monochromatic, parallel light only. 3 figures. (RWR)

STATISTICAL PHYSICS AND THERMODYNAMICS

REFER ALSO TO CITATION(S) 9603

10040 Computer studies on fluid systems of hard-core particles. Wood, W.W. (Los Alamos Scientific Lab., NM). pp 331-388 of In Fundamental problems in statistical mechanics. Vol. III. Cohen, E.D.G. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

The two principal techniques used in computational studies of the equilibrium and transport properties of simple models of molecular systems, viz., the "Monte Carlo" and the "molecular dynamics" methods, are reviewed with an emphasis on conveying an understanding of the principles upon which they are based and an appreciation of their limitations, rather than a concentration on details of implementation. A few of the principal results which have been obtained to date are summarized, and some current studies of the self-diffusion process are described. 14 figures, 4 tables. (RWR)

10041 Experimental thermal expansions for solid neon, 2 to 14°K. Holste, J.C.; Swenson, C.A. (Ames Lab., IA). *J. Low Temp. Phys.;* **18**: No. 5/6, 477-485(1975).

Linear thermal expansion measurements are reported for free-standing samples of neon at temperatures from 2 to 14 K. After normalization, the results agree well with x-ray data in an overlap region between 8 and 14 K. The T = 0 Greuneisen parameter $\gamma_0 = 2.58$ (+- 0.05) is in excellent agreement with the results obtained from high-pressure equation of state data. Smoothed thermodynamic functions for solid neon at saturated vapor pressure are tabulated, and inconsistencies in published high-temperature bulk modulus results are discussed. (auth)

10042 Theory of magnetized ising antiferromagnets at low temperatures. Goldstein, L. (Los Alamos Scientific Lab., NM). *J. Low Temp. Phys.;* **20**: No. 5/6, 637-653(1975).

The exact low-temperature series-expansion formalism of spin 1/2 anisotropic Ising two-sublattice antiferromagnets will be discussed in their parallel magnetic field configuration. In terms of reduced temperature and reduced field strength, defined through the molecular-field spin-ordering transition temperature and the associated critical magnetic field strength of the system, at asymptotically low temperatures, the various thermal properties are expressed through a few exponential terms. At large values of a unique dependent variable of the theory and in leading order the exact formalism is identical with that of molecular-field theory of the above systems. The entropy at constant field strength, approaching critical strength, remains very large down to quite low temperatures. As a consequence, in eventual real systems of low transition temperature which behave predominantly as Ising antiferromagnets or which closely simulate the latter, adiabatic magnetization up to the neighborhood of the critical field strength should produce substantial cooling, provided certain possible competing nucl warming effects remain reasonably small. The heat capacity at constant applied field strength, approaching critical strength, develops a low-temperature maximum in addition to its transition anomaly along the antiferromagnetic—paramagnetic phase boundary line. This exact result, found earlierin, and attributed to, the approximate molecular-field theory, might be useful for experimentally identifying the presence or absence of dominant Ising-like interactions in certain eventual real anisotropic antiferromagnets. (auth)

10043 Scaling behavior at zero-temperature critical points. Baker, G.A. Jr.; Bonner, J.C. (Brookhaven National Lab., Upton, NY). *Phys. Rev., B;* **12**: No. 9, 3741-3744(1 Nov 1975).

A scaling form for the logarithm of the partition function suitable for a zero-temperature critical point is obtained and found to hold for the spherical model in less than two dimensions and the classical n-component Heisenberg linear chain. Nevertheless, several cases are found where the critical-exponent relations involving the specific heat fail. These anomalous cases do not imply a breakdown of the scaling implicit in the basic formulation of renormalization-group theory. (auth)

ELECTRICITY AND MAGNETISM

REFER ALSO TO CITATION(S) 10031

10044 (UCID—16963) **W2T-ARIZ/LLL1: a time-domain code for studying electromagnetic shielding by wire gratings.** Bevensee, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Nov 1975. Contract W-7405-Eng-48. 57p. Dep. NTIS $5.45.

This code is an extension of the code ARBANG developed at the University of Arizona. The original code solved for the temporal e/sub z/(anti rho,t) field on the shadow side of a single planar grating of round, equally spaced parallel wires excited by an incident plane wave of temporal excitation composed of two decaying exponentials. The incident field is polarized parallel to the wires, the system is infinitely long in that direction, and the angle of incidence is arbitrary. The extended code W2T-ARIZ/LLL1 which was developed at Lawrence Livermore Laboratory (LLL) computes the e/sub z/(anti rho,t) field at any point in empty space for any one of three cases: (1) a single grating of ARBANG, (2) a pair of parallel gratings (with the wires parallel), and (3) one grating with a perfectly conducting plane some distance away. The theoretical basis of the code is presented and the accompanying code listing is explained. Some limitations are noted and sample computations for a particular data set are discussed. Information is given about code storage- and execution-time. (auth)

10045 (UCRL—51985) **Approximations for terms related to the kernel in thin-wire integral equations.** Poggio, A.J.; Adams, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1975. Contract W-7405-Eng-48. 42p. Dep. NTIS $4.00.

Difficulties can arise in the evaluation of elements in the impedance matrix associated with a moment-method solution of the thin-wire electric field integral equation. The results of a detailed study are presented, and several representations are considered and compared. From information regarding errors, regions of acceptability are obtained. The deficiencies in the thin-wire kernel are clearly illustrated and remedies are suggested. 22 figures, 2 tables. (auth)

10046 Electrostatic forces between conducting spheres at constant potentials. Warren, W.E.; Cuthrell, R.E. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.;* **46**: No. 10, 4597-4599(Oct 1975).

A derivation in the bispherical coordinate system is presented for the electrostatic force between conducting spheres at a constant potential difference. The theoretical results are compared with experimentally measured forces. (auth)

MATHEMATICAL PHYSICS

10047 (LA—6071) **Integration methods for uncoupled and coupled thermoelastic problems.** Axford, R.A. (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-Eng-36. 22p. Dep. NTIS $4.50.

A unified method based upon a single quadrature logic can be used to compute transient thermal stresses in the uncoupled, quasi-static; the uncoupled; and the coupled, thermoelastic approximations. Instantaneous heat fluxes at the boundaries of finite media lead to infinite surface stresses, but these singularities can be removed by using instantaneous volumetric heat sources spread over thin regions adjacent to a surface. (auth)

COMMUNICATION, EDUCATION, HISTORY, AND PHILOSOPHY

REFER ALSO TO CITATION(S) 10181

CONTROLLED THERMONUCLEAR RESEARCH

10048 PHYSICS AND THE ENERGY INDUSTRY. SUMMER SCHOOL IN PHYSICS, BEDFORD PARK, AUSTRALIA, JANUARY 1974. Bedford Park, Australia; Australia; Flinders University of South Australia (1974). 168p. (CONF-740137—).

From Summer school on physics and the energy industry; Bedford Park, Australia (Jan 1974).

This volume contains notes prepared by lecturers at the School; three lectures on "fission reactors" are combined, as well as two lectures on "some topics in plasma physics." Of the eight separate items, three abstracts are included for NSA and four for ERA; one item, "Conventional Electricity Generation," is indexed only for the ERDA Energy Data Base. (LMT)

10049 (ERDA-tr—66, pp 14-18) **Plasma installations of Institute of Nuclear Physics of Siberian Branch of USSR Academy of Sciences.** Oct 1975. Translation of Russian paper.

In Selected USSR papers on plasma physics and controlled thermonuclear fusion.

Brief descriptions are given of the following devices: GOL-1 installation, VODA pulse generator to produce a heavy-current relativistic electron beam, INAR installation, PSP-1, and PSP-2. (MOW)

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

10050 (CONF-751125—129) **Radio frequency plasma heating in large tokamak systems near the lower hybrid resonance.** Deitz, A.; Hooke, W.M. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 12p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The frequency range, power, efficiency, and pulse length of a high power rf system are discussed as they might be applied to the TFTR Tokamak facility as well as on a full scale reactor. Comparisons are made of the size, power output, and costs to obtain microwave power sufficient to satisfy the physics requirements. A new microwave feed concept is discussed which will improve the coupling of the microwave energy into the plasma. The unique advantages of waveguide feed systems is apparent when one considers the practical problems associated with coupling supplementary heating energy into a reactor. (auth)

10051 (CONF-751125—130) **200 kW, 800 MHz transmitter system for lower hybrid heating.** Deitz, A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 16p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper describes a new rf heating system which has just been completed and is now operational on the ATC machine. The system utilizes four UHF TV klystrons to generate at least 200 kW of power at a frequency of 800 MHz. Pulse widths can be varied from 20 μsec up to 20 msec. A radar type floating deck modulator along with photo-optical transmitting and receiving devices have been incorporated into the system to provide the pulse fidelity and versatility which characterizes this equipment. Modular construction was emphasized in the design, when possible, to reduce maintenance and down time in the advent of component falilure. Hybrid combining techniques are utilized in order to provide two 100 kW feeds into the machine. (auth)

10052 (COO—2218-60P) **Preliminary study of suprathermal alpha particle heating.** Miley, G.H.; Petrie, T.W.; Rao, M.P.; Hively, L.H. (Illinois Univ., Urbana (USA)). 1975. 11p. (CONF-751130—18). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Some of the consequences of the suprathermal orbits on particle confinement and heating are examined. The guiding-center approximation along with the conservation equations of energy, magnetic moment, and canonical angular momentum were used in the analysis. An example calculation is presented. (MOW)

10053 (MATT—1180) **Fusion reactivities and neutron source characteristics of beam-driven toroidal reactors with both D and T injection.** Jassby, D.L.; Towner, H.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 60p. Dep. NTIS $5.45.

The reactor performance is considered for intensely beam-driven tokamak plasmas with 50:50 D-T composition maintained by neutral-beam injection of both D and T, together with plasma recycling. The D and T are injected with equal intensity and velocity. This mode of operation is most appropriate for high-duty-factor, high-power-density operation, in the absence of pellet injection. The isotropic velocity distributions of energetic D and T ions (for multi-angle injection) are calculated from a simple slowing-down model, but include a tail above the injection velocity. The neutron source characteristics are determined from fusion reactivities calculated for beam-target, hot-ion, and thermonuclear reactions. For conditions where Q approximates 1, beam-target reactions are dominant, although reactions among the hot ions contribute substantially to P/sub fusion/ when n/sub hot//n /sub e/ greater than or equal to 0.2. (auth)

10054 (UCID—16962) **Cold component flow in a two-component mirror machine.** Rognlien, T.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1975. Contract W-7405-Eng-48. 35p. Dep. NTIS $4.00.

Steady-state solutions are given for the flow characteristics along the magnetic field of the cold plasma component in a two-component mirror machine. The hot plasma component is represented by a fixed density profile. The fluid equations are used to describe the cold plasma, which is assumed to be generated in a localized region at one end of the machine. The ion flow speed, v/sub i/, is required to satisfy the Bohm sheath condition at the end walls, i.e., v/sub i/ greater than or equal to c/sub s/, where c/sub s/ is the ion-acoustic speed. For the case when the cold plasma density, n/sub c/, is much less than the hot plasma density, n/sub h/, the cold plasma is stagnant and does not penetrate through the machine in the zero temperature case. The effect of a finite temperature is to allow for the penetration of a small amount of cold plasma through the machine. For the density range n/sub c/ approximately n/sub h/, the flow solutions are asymmetric about the midplane and have v/sub i/ = c/sub s/ near the midplane. Finally, for n/sub c/ much greater than n/sub h/, the solutions become symmetric about the midplane and approach the Lee—McNamara type solutions with v/sub i/ = c/sub s/ near the mirror throats. (auth)

10055 (UCRL—52000-75-11) **Energy and technology review.** Carr, R.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. 26p. Dep. NTIS $4.00.

Four articles are presented on: magnetically confined plasmas, laser research; rock drilling with water jets; and nonelectrical uses of geothermal energy. A separate abstract was prepared for each article. (LCL)

10056 Quantum theory of inverse bremsstrahlung absorption and pair production. Seely, J.F. (Univ. of Tennessee, Knoxville). pp 835-847 of In Laser interactions and related plasma phenomena. Vol. 3. New York; Plenum Press (1974).

The inverse Bremsstrahlung process is believed to play an important role in the heating of plasma electrons by laser radiation. In this process, an electron absorbs energy from the laser beam during a collision with a nucleus. From a classical viewpoint, the electron oscillates in the electric field of the laser beam. During a collision with a nucleus, the electron is knocked out of phase

with the electric field, and the oscillatory energy of the electron is converted to random thermal energy. From a quantum viewpoint, the electron can gain energy only in units of Dirac constantω, where ω is the frequency of the laser radiation, and it is not clear that the classical theory is valid. The quantum theory of inverse Bremsstrahlung absorption is discussed, and compared with the quantum results to the classical results. (auth)

10057 Fusion dynamics of lossy reactor systems and power balance implications. McNally, J.R. Jr.; Clarke, J.F.; Fowler, R.H.; Hiraoka, T.; Sharp, R.D.; Steiner, D. (Oak Ridge National Lab., TN). pp 511-523 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

Nuclear-fusion reactivity calculations are reported for zero-dimensional, magnetically confined, lossy reactor systems after the methodology of Etzweiler, Clarke and Fowler. These systems are radiation-damped, dissipative-trapped-particle-loss-mode-dominated DT-fuelled tokamak reactors. Injection of a mixed energetic neutral beam of D^0 and T^0 at $E_0 = 300$ keV heats the plasma to ignition following which a thermal runaway occurs until the increasingly severe dissipative trapped-ion losses lead to a plasma "blow-out" phenomenon. The blow-out process is identified with the use of too high an injection energy. Reduction of the fuel injection energy below the instability value permits steady-state reactor operation at high Q/sub eta/(= P/sub out//P/sub in/). A steady-state tokamak can operate, in principle, at $E_0 = 25$ keV after ignition with $E_0 = 300$ keV neutrals with a Q/ sub eta/ of 22. The temperature perturbation of such a steady-state reactor leads to a negative temperature coefficient; source perturbations give a positive density coefficient which must be carefully controlled to prevent excessive wall loading; magnetic field perturbations give a positive field coefficient which would permit positive feedback control on the reactivity. The power balance implications are assessed on the following assumptions: (1) The neutral beam injectors have an efficiency of 70 percent. (2) The pulsed magnetic field energy is supplied by a superconducting magnetic-energy storage and transfer system having an efficiency of 90 percent and approximately 80 percent of the pulsed magnetic energy is recovered at the end of each cycle. (3) The efficiency of the thermal conversion system is 40 percent. With these assumptions, a Q/sub eta/ of about 14 is required in order to achieve net power production with an overall plant efficiency of 30 percent. To achieve power break-even, a Q/sub eta/ of about 3 is necessary. (auth)

10058 Parametric survey for the linear two-component system. Heckrotte, W.; Hiskes, J.R.; Freis, R.P. (Univ. of California, Livermore). pp 557-568 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

A parametric study is presented for the linear, two-component, mirror fusion system in which the interrelationship of the important system parameters is displayed. The distribution function of the high-energy component and related functions are calculated from the Fokker-Planck equation. The functions are conveniently parametrized by the ratio of injection energy to the target electron temperature. The Q-values for the two-component system are found to be increasing functions of the injection energy up to 200 keV and then to exhibit a broad maximum from 200 to 600 keV. The optimum Q values are significantly greater (greater than 2) than for the conventional mirror system. System lengths are derived as a function of the magnetic field, target electron temperature, plasma potential, and α-particle heating. For a given Q (or injection energy/electron temperature ratio) the system lengths, which may be long, are balanced against magnetic-field values, which may be large. Effective bounds on several parameters are established. The presence of α-particles in the system may result in the development of a deuterium "halo" surrounding the target plasma, which can severely attenuate the incident beam. Accommodation of these "halo" effects necessitates a longer system. (auth)

10059 Theoretical studies of plasma heating by relativistic electron beams. Papadopoulos, K.; Chu, K.R.; Clark, R.W. (Naval Research Lab., Washington, DC). pp 231-240 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

A summary of ongoing theoretical investigations with respect to plasma heating by relativistic electron beams is presented. The investigations include nonlinear stabilization by parametric effects, nonlinear saturation of cold two-stream instability, 2D-particle simulations, studies of the filamentation instability, formation of and plasma heating by rotating electron beams and expansion of a column of beam-heated plasma. (auth)

10060 Plasma heating using strong turbulence and relativistic electron beams. Kribel, R.E.; Ekdahl, C.E.; Greenspan, M.; Sethian, J.; Sandel, F.; Wharton, C.B. (Cornell Univ., Ithaca, NY). pp 241-248 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

A mirror-confined plasma column (plasma density n/sub p/ less than or equal to 6 x 10^{13} cm^{-3}) was heated by current-driven turbulence and by the injection of a relativistic electron beam along the magnetic field. In experiments performed with low-current beams (beam current I less than or equal to 21/sub A/ = 2 x 17 kA) the energy per electron-ion pair transferred to the plasma increased linearly with the beam to plasma density ratio n/sub b//n/sub p/. In these experiments the electron heating is attributed to the electron-electron beam plasma interaction while the energetic ions are probably produced by an electrostatic acceleration. After heating, the plasma column oscillates radially with a frequency ω proportional to the Alfven velocity (ω varies as B $n^{-1}/_2$/sub p/ where B is the confining field). At the higher plasma densities, energetic confined electrons were detected, and are attributed to interactions with waves propagating at large angles to the beam. (auth)

10061 Plasma heating with a rotating relativistic electron beam. Molvig, K.; Rostoker, N.; Dothan, F. (Univ. of California, Irvine). pp 249-256 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

Previously studied processes by means of which energy is transferred from an intense relativistic electron beam to a plasma involve instabilities associated with the primary energetic electrons and indirect coupling of the plasma return current. For return current coupling, a simple treatment based on diffusion equations was developed so that boundary conditions, pulse shape, etc., can be accounted for. This treatment was applied to a rotating beam produced, for example, by passing an annular beam through a magnetic cusp. The result is that an electric field is set up within the plasma by the Hall effect. The magnitude of this electric field is E/sub r/ = 300(n/sub p//n/sub p/)B/sub z/ where n/sub b/ is the beam density, and n/sub p/ is the plasma density; E/sub r/(kV cm^{-1}) and B/sub z/(kG) are the electric and magnetic fields. The guiding-center drift of electrons at velocity v/sub theta/ = cE/sub r//B/sub z/ accounts for the plasma return current. Ions for which the magnetic field can be neglected would be accelerated in the E/sub r/-field to multi-kilovolt energy. The stopping power of the beam is greatly enhanced compared to a non-rotating beam, and the energy is almost entirely transferred to the ions. The coupling does not involve instabilities. (auth)

10062 Turbulently heated high-voltage theta pinch. Oktay, E.; Desilva, A.W.; Liewer, P.C.; Chen, Y.G.; Griem, H.R.; Hess, R.; Krall, N.A. (Univ. of Maryland, College Park). pp 365-371 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

The heating of a plasma in a fast theta pinch is described in experiment and numerical simulation. The initial plasma parameters are $n_0 = 3 \times 10^{12}$ to 3 x 10^{13} cm^{-3}, T_0 less than 1 eV, and B_0 = +-175 G. A shock-like disturbance created by a fast current pulse heats and compresses the plasma. Heating is attributed principally to drift instabilities, namely the Buneman two-stream, the modified two-stream and the ion sound instabilities. Experimental evidence is presented for heating of electrons to approximately 10 keV and ions to temperatures from 3 to tens of keV, depending upon initial conditions. Strongest heating and compression is seen at the lowest densities with antiparallel orientation of bias and pulse magnetic fields. Evidence of turbulent fields is seen, as well as indication of rapid heat loss out the ends of the tube. A numerical model describes the implosion using a a two-fluid code with transport modified by local turbulent fields. These are in turn computed from linear and quasi-linear theory. Model and experiment show

agreement in overall dynamical behavior but fail to agree in details of electron and ion heating and sheath thickness. (auth)

10063 Implosion heating studies in the Scylla 1B, implosion heating, and staged theta-pinch experiments. Gribble, R.F.; Hammel, J.E.; Henins, I. (Los Alamos Scientific Lab., NM). pp 381-388 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

Three experiments designed to study various aspects of implosion heating in the plasma density range (10^{14} to 10^{16} cm^{-3}) used in present theta pinches are described. Initial plasma studies show that, provided a sufficiently high pre-ionization level (greater than 10^{14} cm^{-3}) is achieved, plasma behavior is qualitatively the same over a range of two in initial magnetic field rise and a range of four in initial gas fill. The implosion phase is characterized by rapid changes in magnetic-field diffusion rates, the plasma resistivity decreasing rapidly with time. During the implosion some of the plasma density observed is moving ahead of the magnetic piston. Magnetic-field gradients occur in the region outside the area of measurable plasma density implying the presence of hot, low-density plasma in this region. In experiments where the external magnetic field decreases before the maximum compression of the plasma column, secondary breakdown occurs at the discharge tube wall which slows the rate at which magnetic flux diffuses out of the discharge tube. (auth)

10064 Theoretical interpretations of enhanced laser light absorption. Kruer, W.L. (Lawrence Livermore Lab., CA). pp 5-26 of In Progress in lasers and laser fusion. Perlmutter, A. (ed.). New York; Plenum Press (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P2.

Classical inverse bremsstrahlung is discussed in relation to plasma heating. Some plasma heating experiments are reviewed. A brief discussion is given of light absorption at high intensity (greater than or equal to 10^{15} W/cm^2, Nd), emphasizing the importance of density profile modifications and the possibility of stimulated scattering of light from the plasma. (MOW)

10065 (UCRL-Trans—10981) **One-dimensional numerical experiment on parametric heating of plasma. Part I.** Sigov, Yu.S.; Khodyrev, Yu.V. (AN SSSR, Moscow). Nov 1975. Translation of Preprint No. 129. 13p. Dep. NTIS $3.50.

Some results of a one-dimensional numerical experiment on high-frequency plasma heating with an external field of frequency $\omega_0 = 1.005\ \omega/sub\ pe/$ and amplitude $E_0\sqrt{4\pi n_0}T/sub\ eo/ = 1$ are presented. The excitation of an aperiodic branch of parametric instability is demonstrated. The effective collision frequency and the proportion of non-Maxwellian electrons are estimated. (auth)

10066 Plasma heating by relativistic electron beams. I. Two-stream instability. Thode, L.E.; Sudan, R.N. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14850). *Phys. Fluids;* **18**: No. 11, 1552-1563(Nov 1975).

A one-dimensional model of the two-stream instability between a relativistic electron beam and a plasma shows that the saturated level of the wave electric field is determined by a single parameter. Due to relativistic effects, the efficiency of energy transfer via the hydrodynamic two-stream instability is a decreasing function of total beam energy in the strongly relativistic regime. The model is supported by numerical simulation experiments. The spectrum of the spatial harmonics generated during the buildup of the primary spectrum obeys a power law dependence. Anomalous heating of the electrons via parametric instability driven by the primary spectrum is observed. For long times the beam energy loss is proportional to the initial beam kinetic energy and most of this energy is picked up by the hot tail of the plasma electron distribution. (AIP)

10067 Plasma heating by relativistic electron beams. II. Return current interaction. Thode, L.E.; Sudan, R.N. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14850). *Phys. Fluids;* **18**: No. 11, 1564-1573(Nov 1975).

The combined interactions of the relativistic two-stream instability and return current driven Buneman/ion sound instability are investigated by numerical simulation for a beam-to-plasma density ratio $\cong 10^{-1}$ and γ=2-8. In this regime the evolution of the two-stream instability is relatively unaffected by the return current instability. The growth rate of the Buneman instability drops sharply when trapping of plasma electrons by the unstable Buneman waves occurs, but wave growth continues at a much reduced rate until other processes, e.g.,ion acceleration, wave scattering, and nonlinear Landau damping set in. Ions are heated by the return current and this heating is almost independent of the initial beam γ for constant return current. The bulk of the electron distribution is heated, whereas in the absence of a return current the two-stream instability primarily produces only energetic tails. The total plasma electron energy after several hundred plasma periods is proportional to the beam energy. The effective collision frequency of the plasma electrons due to microturbulence is typically $0.2 \cong 0.4\ \omega/subi/$, where $\omega/subi/$ is the ion plasma frequency. In the strong turbulence created by the electron beam and the return current, the wave energy spectrum scales as $vertical\text{-}barE/subk/vertical\text{-}bar^2 \cong k^{-2}$. (AIP)

10068 High-energy runaway electrons in the Oak Ridge tokamak. Knoepfel, H.; Zweben, S.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **35**: No. 20, 1340-1343(17 Nov 1975).

Measurement of hard x-rays produced in normal ORMAK discharges provides direct evidence that runaway electrons can be produced at early times and can be contained stably during the whole discharge time, thereby attaining energies of the order of 10 MeV. This class of high-energy runaway electrons complements and extends previous information on runaways in toroidal discharges and can have some distinct consequences on the operation of future tokamak devices. (AIP)

10069 Stabilization of a neutral-beam—sustained, mirror-confined plasma. Coensgen, F.H.; Cummins, W.F.; Logan, B.G.; Molvik, A.W.; Nexsen, W.E.; Simonen, T.C.; Stallard, B.W.; Turner, W.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev. Lett.;* **35**: No. 22, 1501-1503(1 Dec 1975).

We report results of plasma confinement experiments with an auxiliary warm-plasma component flowing along magnetic field lines to suppress ion-cyclotron instabilities. The reduced plasma losses, with the lower fluctuation amplitude, permits neutral-beam buildup of a 13-keV deuterium plasma to densities as high as 4×10^{13} cm^{-3} corresponding to peak beta values of 0.4. Variation of the beam energy demonstrates that longer confinement times are achieved at higher ion energies. (AIP)

10070 Impurity transport in a quiescent tokamak plasma. Cohen, S.A.; Cecchi, J.L.; Marmar, E.S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). *Phys. Rev. Lett.;* **35**: No. 22, 1507-1510(1 Dec 1975).

We have injected short bursts of aluminum into the adiabatic-toroidal-compressor (ATC) tokamak, and measured the time evolution of the radial distribution of highly ionized states of aluminum. The results are compared with a computer code describing neoclassical impurity diffusion. (AIP)

10071 Charged-particle orbits in sheared magnetic fields; implications to diffusion. Gell, Y.; Harte, J.; Lichtenberg, A.J.; Nevins, W.M. (Department of Electrical Engineering and Computer Sciences and the Electronics Research Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **35**: No. 24, 1642-1645(15 Dec 1975).

Charged-particle motion across a sheared magnetic field and electrostatic wave is studied. Resonant-particle orbit widths are derived; two parametric dependences are found in the limits that the particle is near or far from the $k/sub\ parallel/=0$ plane, with a smooth transition between the two. The orbit widths are used to calculate diffusion coefficients in tokamak-type configurations. These predictions are confirmed by test-particle computer simulations in (x, y, $v/subx/$, $v/suby/$, $v/subz/$) coordinates employing a Monte Carlo collision operator. (AIP)

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 9244, 9354, 10008

10072 (CONF-751125—118) **Data acquisition for PLT.** Thompson, P.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 40p. Dep. NTIS $4.00.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

DA/PLT, the data acquisition system for the Princeton Large Torus (PLT) fusion research device, consists of a PDP-10 host computer, five satellite PDP-11s connected to the host by a special high-speed interface, miscellaneous other minicomputers and commercially supplied instruments, and much PPPL produced hardware. The software consists of the standard PDP-10 monitor with local modifications and the special systems and applications programs to customize the DA/PLT for the specific job of supporting data acquisition, analysis, display, and archiving, with concurrent off-line analysis, program development, and, in the background, general batch and timesharing. Some details of the

over-all architecture are presented, along with a status report of the different PLT experiments being supported. (auth)

10073 (CONF-751125—120) **Transient analyzer.** Muir, M.D. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 14p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The design and design philosophy of a high performance, extremely versatile transient analyzer is described. This sub-system was designed to be controlled through the data acquisition computer system which allows hands off operation. Thus it may be placed on the experiment side of the high voltage safety break between the experimental device and the control room. This analyzer provides control features which are extremely useful for data acquisition from PPPL diagnostics. These include dynamic sample rate changing, which may be intermixed with multiple post trigger operations with variable length blocks using normal, peak to peak or integrate modes. Included in the discussion are general remarks on the advantages of adding intelligence to transient analyzers, a detailed description of the characteristics of the PPPL transient analyzer, a description of the hardware, firmware, control language and operation of the PPPL transient analyzer, and general remarks on future trends in this type of instrumentation both at PPPL and in general. (auth)

PLASMA KINETICS - GENERAL

10074 (CONF-750356—, pp T1-T70) **Thermal fluctuations in plasmas.** Thompson, W.B. (Univ. of California, San Diego, La Jolla). 1975.

From 2. international congress on waves and instabilities in plasmas "SICWIP"; Innsbruck, Austria (17 Mar 1975).

In Second international congress on waves and instabilities in plasmas. Survey lectures.

A survey is presented of the fluctuations to be expected in plasmas. A resume of the familiar test particle results is followed by a derivation of the wave transport equation and an examination of the effects of plasma nonuniformity on the fluctuation spectrum. The effect of a magnetic field is then examined, where, in addition to the modes of a uniform plasma, drift waves also appear. Observable effects on fluctuations are discussed and the scattering cross section form factor evaluated. (auth)

10075 (ERDA-tr—66) **Selected USSR papers on plasma physics and controlled thermonuclear fusion.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Controlled Thermonuclear Research). Oct 1975. Translation of Russian papers. 61p. Dep. NTIS $5.45.

Separate abstracts were prepared for the nine included papers. (MOW)

10076 (ERDA-tr—66, pp 1-7) **Some results of studies on plasma physics and controlled thermonuclear fusion in 1974—1975 in direction of "physics research".** Kartashev, K.B. Oct 1975. Translation of Russian paper.

In Selected USSR papers on plasma physics and controlled thermonuclear fusion.

A review is given of plasma research in USSR during 1974—1975. Brief statements on each research program are included. (MOW)

10077 Two-dimensional ion effects in relativistic diodes. Poukey, J.W. (Plasma Theory Division, Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Vac. Sci. Technol.;* **12**: No. 6, 1214-1217(Nov 1975).

In relativistic diodes, ions are emitted from the anode plasma. The effects and properties of these ions are studied via a two-dimensional particle-simulation code. The space charge of these ions enhances the electron emission, and this additional current (including that of the ions themselves) aids in obtaining superpinched electron beams for use in pellet fusion studies. (AIP)

10078 Motion of a plasma column in a perturbing magnetic field. Miller, G. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **18**: No. 12, 1704-1709(Dec 1975).

The motion of a plasma column acted upon by a small external magnetic field is calculated using the sharp-boundary ideal magnetohydrodynamic model. The natural oscillation frequencies of the system are obtained. For the theta pinch, simple approximate formulas useful in considering feedback and dynamic stabilization schemes are derived. (AIP)

PLASMA KINETICS - EXPERIMENTAL

10079 Plasma experiments in the Scyllac toroidal theta pinch. Cantrell, E.L.; Ellis, W.R.; Harris, H.W. (Los Alamos Scientific Lab., NM). pp 13-23 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

Experiments on plasma equilibrium and stability in the Scyllac full torus, and in earlier 5-m and 8-m toroidal sectors, are reported. In all these experiments, the outward toroidal drift was compensated by a combination of $l = a$ helical and $l = 0$ bumpy fields generated by shaping the inner surface of the compression coil or by driven $l = 1$ windings. Time-resolved measurements of the gross plasma column motion, plasma radius, excluded flux, external magnetic field, plasma density, electron and ion temperatures, and plasma beta have been made. Preliminary results show that the plasma behavior in the 8-m sector and the full torus (both with major radius $R = 4$ m) is qualitatively the same, with a well-defined, theta-pinch-type plasma column being formed in both cases. No plasma shredding or evidence of microinstabilities is seen, and no m greater than or equal to 2 modes have been observed. The plasma confinement lasts typically 6 to 10 μs, and is terminated by a long-wavelength, $m = 1$-type motion which carries the plasma column to the wall with an effective growth rate of 0.5 to 1.0×10^6 s^{-1}. Photographs from a 360° framing camera mounted on the torus axis show this motion to consist of at least $n = 0$, 1, and 2, where m and n describe motions of the form exp i(mTHETA-nz/R). A net toroidal current of 1 to 1.5 kA flowing opposite to B_θ has been measured; this current appears to be too small to account for the experimental growth rate in terms of the current-driven Kruskal—Shafranov mode. (auth)

10080 Relativistic electron dynamics in a cusped magnetic field with a downstream drift region. Destler, W.W.; Misra, P.K.; Rhee, M.J. (University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **18**: No. 12, 1820-1822(Dec 1975).

Studies are reported of the motion of relativistic electrons injected first through a narrow magnetic cusp and then into a downstream region in which the particle motion is assumed to be adiabatic. Experiments performed to check the theory are also presented. (AIP)

PLASMA KINETICS - THEORETICAL

10081 (CONF-751125—103) **Transformation of the single energy group transport, equation to axissymmetric toroidal coordinates.** Gralnick, S.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 4p. Dep. NTIS $4.00.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The streaming term of the single energy group transport equation was derived for a general class of axisymmetric toroidal geometries using a tensor transformation formalism. The particular case of nested circular toroids treated previously by Pomraning and Stevens may be obtained by direct substitution into the equation. Other, more complicated geometries of interest to plasma physics and fusion reactor research are obtainable in the same manner. The cylindrical limit in which the azimuthal curvature is neglected may be obtained by taking the ratio of the poloidal curvature to X^1, the toroidal curvature, to zero. Similarly the planar limit results when both curvatures are small compared to the inverse of the physical dimension measured normal to the toroidal surface. (auth)

10082 (ERDA—115) **Symbolic computation in controlled thermonuclear research.** (Energy Research and Development Administration, Washington, D.C. (USA)). Mar 1974. 14p. Dep. NTIS $4.00.

The following report summarizes the panel's deliberations and makes recommendations for further ERDA activity in the area of symbolic computation. A listing is given of the types of problems which have already been solved by symbolic computation, as well as a discussion of the various software systems which have been used. A detailed discussion is given of areas of CTR research where symbolic computation is of potential usefulness. The best attempts of the panel to estimate the potential usage of symbolic computation by the CTR community are outlined. The detailed recommendations of the panel are given. (auth)

10083 (TID—26913) **General plasma physics I, Fall semester 1973.** Furth, H.P.; Rutherford, P.H. (Princeton Univ., N.J. (USA). Palmer Physical Lab.). 1973. Contract AT(11-1)-3073. 237p. Dep. NTIS $9.00.

A total of 34 lectures on various aspects of plasma physics is given. The lectures cover collisions, orbit theory, particle confinement in a torus, fluid properties of plasma, atomic processes, the Vlasov equation, transport equations, plasma diffusion, plasma waves, and Landau damping. (MOW)

10084 Computational studies of two-component mirror reactors. Byers, J.A.; Freis, R.P.; Killeen, J.; Lee, E.P.; McNamara, B.; Mirin, A.A.; Rensink, M.E. (Univ. of California, Livermore). pp 551-556 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

An extensive study was made of the energetics, equilibrium, and stability of two-component mirror systems. Collisional target plasmas are described by equilibrium fluid flow equations in the Marteni computer code. The Marteni code is coupled to a particle simulation code for application to an arc target plasma. The particle code determines the net transfer of directed beam energy to the plasma (typically 10 to 15 percent maximum) and this produces input for the power balance of the Marteni code that determines T/sub e/. For two-component systems supported by neutral injection, we couple the Marteni code to Fokker-Planck (MFP) codes that describe the collisional decay of the injected species. A radial transport code that gives information on the trapping fraction of the neutral beam and on volume erosion of the target plasma is included. In the simplest cases, the codes produce predictions of T/sub e/ that are a factor of 2 to 3 lower than previous estimates. Self-consistent magnetic field effects are calculated with a particle simulation code that shows long-lived reversed-field configurations are possible. The MFP codes predict that velocity space instabilities are definitely present during the build-up phase, will occur even in the steady state for low mirror ratios, R approximately 2, and can possibly be stabilized by high mirror ratios R greater than or equal to 10. Particle simulation codes predict a spreading of the hot-ion energy spectrum. (auth)

10085 Theoretical and numerical studies of high-β plasmas. Krall, N.A. (Lab. for Applied Plasma Studies, La Jolla, CA); Hamasaki, S.; Davidson, R.C. pp 373-380 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

A fluid-numerical model which has been successful in predicting and explaining theta-pinch behavior is further applied and extended. One application is to the study of the structure of equilibrium sheaths in finite-beta plasmas; in addition, the code is extended to include effects found in higher-density partially ionized experiments and applied to calculation of the behavior of the Scylla 1-B experiment. A major extension of the technique is to combine the fluid electron code with a particle simulation code to include the effect of reflected ions; this code is applied to a study of implosion heating of the LASL toroidal screw pinch ZT-1. A numerical technique is devised for initializing two-dimensional particle-in-cell simulation of pinch sheath evolution, and examples of equilibrium are presented. (auth)

10086 (ERDA-tr—66, pp 8-13) **Tokamaks and dimensional analysis.** Kadomtsev, B.B. (Inst. of Atomic Energy, Moscow). Oct 1975. Translation of Russian paper.

In Selected USSR papers on plasma physics and controlled thermonuclear fusion.

The behavior of a completely ionized pure hydrogen plasma in a tokamak is studied. Since all the quantum phenomena in this postulation are excluded, the behavior of this plasma is determined completely by classical laws of the motion of its charged particle components and by the Maxwell equations for an electromagnetic field. The theoretical analysis is presented. (MOW)

10087 Plasma simulation using particle codes. Kruer, W.L. (Univ. of California, Livermore). *Nucl. Technol.*; **27**: No. 2, 216-223(Oct 1975).

Particle codes are a powerful tool for the numerical simulation of nonlinear plasma behavior. In these codes, one follows the motion of a large number of electrons and ions in their self-consistent (plus externally imposed) electric and magnetic fields. The fields are solved for on a spatial grid chosen to resolve the collective behavior of the plasma (i.e., the plasma waves). The interpolation between the grid and the particle positions corresponds physically to a multipole expansion of finite-size charges about their nearest grid point location. Results from particle codes agree with numerical solutions of the Vlasov equation. In laser fusion applications, particle codes are used to study the absorption of laser light. (auth)

10088 (UCRL-Trans—10980) **Numerical modelling of two-dimensional Langmuir turbulence.** Polyudov, A.N.; Sagdeev, R.Z.; Sigov, Yu.S. (AN SSSR, Moscow). Nov 1975. Translation of Preprint No. 128. 44p. Dep. NTIS $4.00.

Within the framework of two-dimensional discrete modelling of plasma in x,y-geometry the evolution of a monochromatic electrostatic wave of large amplitude has been investigated. The kinetic effects associated with the self-focussing of Langmuir oscillations are considered. Expressions are obtained for the effective collision frequency, the form of the distribution function, and spectra of strong Langmuir turbulence. (auth)

10089 Improved variational method for axisymmetric plasmas. Shumaker, D.E.; Bernstein, I.B. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Fluids;* **18**: No. 11, 1487-1488(Nov 1975).

An improved variational method for determining transport coefficients in axisymmetric plasmas is given. The advantage of the method is that the induction electric field is determined as an independent unknown and can be approximated by means of trial functions. (AIP)

10090 A hybrid-kinetic model for high-β plasmas. D'Ippolito, D.A.; Davidson, R.C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **18**: No. 11, 1507-1523(Nov 1975).

A hybrid-kinetic model (Vlasov ions and drift-kinetic electrons) is developed to describe the equilibrium and stability properties of collisionless high-beta plasmas in arbitrary magnetic field configurations. No ordering of ion properties (such as ω/Ω/subi/ and r/subL//subi//L/sub perpendicular/) is assumed, so the ions are described by the exact (unexpanded) Vlasov equation. The electrons are assumed to be strongly magnetized with ω/Ω/sube/ ~r/subL//sube//L/sub perpendicular/=ϵvery-much-less-than1, and the electron Vlasov equation is expanded in ϵ to give a drift-kinetic equation for f/sube/. Examples of linear screw-pinch equilibria are constructed to demonstrate the ease with which equilibrium solutions are found within this formalism. Also, it is shown that the hybrid-kinetic model correct to O (ϵ) includes physical effects which are important during the implosion and immediate post-implosion phases of high-density pinch experiments, where stability behavior is characterized by the fast time scale ω^{-1}/subL//subH/= (Ω/sube/Ω/subi/)$^{-1/2}$. In particular, a local dispersion relation is derived for the modified-two-stream and lower-hybrid-drift instabilities, which have characteristic growth rates of order (Ω/sube/Ω/subi/)$^{1/2}$ when ω^2/subp//sube//Ω^2/sube/ very-much-greater-than1. (AIP)

10091 Three-dimensional guiding-center plasmas. Knorr, G. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). *Phys. Fluids;* **18**: No. 11, 1546-1551(Nov 1975).

A three-dimensional guiding-center plasma model is derived from the Vlasov equation using a method by Frieman, Davidson, and Langdon. In two dimensions the reduction of the description to configuration space occurs only for homogeneous magnetic fields. Macroscopic equations are derived for a homogeneous magnetic field and the stability of nonneutral plasmas is investigated. Sheets consisting of magnetic field lines and charged positively show unstable behavior if k/sub parallel//k/sub perpendicular/<a/c /subs/, where a is the ExB drift and c/subs/ is the ion sound velocity. k/sub parallel/ and k/sub perpendicular/ are the wavenumbers parallel and perpendicular to the magnetic field. Sheets with electron charges are stable if the phase velocity of the disturbance along B is smaller than the electron thermal velocity. (AIP)

10092 Three-dimensional magnetohydrodynamic equilibria of toroidal stellarators. Shohet, J.L.; Anderson, D.T.; Betancourt, O.L.; Tataronis, J.A. (University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev. Lett.*; **35**: No. 21, 1433-1436(24 Nov 1975).

Fully nonaxisymmetric magnetohydrodynamic equilibria have been calculated numerically for the Proto-Cleo stellarator utilizing a fully three-dimensional magnetohydrodynamic equilibrium code. It was found that recently observed anomalous circulating currents in stellarators may be a result of the equilibrium condition. (AIP)

10093 Rigid-rotor equilibria of nonneutral plasmas. Theiss, A.J.; Mahaffey, R.A.; Trivelpiece, A.W. (University of Maryland, Department of Physics and Astronomy, College Park, Maryland 20742). *Phys. Rev. Lett.*; **35**: No. 21, 1436-1438(24 Nov 1975).

A cold, constant-density, cylindrical, nonneutral plasma column confined by a uniform axial magnetic field has equilibria characterized by rigid-rotation frequencies given by θ=1/2ω /subc/1plus-or-minus (1-2ω/subp/ ^{2}/ω/subc/ ^{2})$^{1/2}$. Measurements of these fast (+) and slow (-) equilibria are compared with a cold-fluid-theory model of nonneutral plasmas. (AIP)

10094 Rigid rotation and surface envelopes of nonneutral-plasma columns. Mahaffey, R.A.; Goldstein, S.A.; Davidson, R.C.; Trivelpiece, A.W. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Rev. Lett.*; 35: No. 21, 1439-1441(24 Nov 1975).

The bulk rotation velocity and surface envelope of a drifting unneutralized electron beam have been measured. These measurements verify various properties predicted by nonneutral-plasma theory. One unusual feature is that in some instances, the bulk rotation is opposite to the normally associated with the equilibria. Rotation at angular velocities greater than ω/subc/ is also observed. In addition, the wavelength of the time-independent surface envelope is found to depend on the amount of ripple present. (AIP)

10095 Initial value problem in relativistic plasma. Godfrey, B.B.; Newberger, B.S.; Taggart, K.A. (Los Alamos Scientific Lab., NM). *IEEE Trans. Plasma Sci.*; **PS-3**: No. 4, 185-193(Dec 1975).

The Landau problem in relativistic plasma is considered in detail. It is shown how all modes in the plasma arise through proper treatment of the inverse Laplace transforms without imposition of any external conditions. A correct derivation of the asymptotic behavior of the electric field is included and estimates of the contribution of more rapidly decaying Landau modes are made analytically and are compared with numerical computations. (auth)

10096 Ion acceleration by the relativistic two-stream instability. Godfrey, B.B.; Thode, L.E.;. (Los Alamos Scientific Lab., NM). *IEEE Trans. Plasma Sci.*; **PS-3**: No. 4, 201-204(Dec 1975).

Through theoretical analysis and computer simulation, one finds that a pinched relativistic electron beam in a plasma interacts strongly with plasma ions by means of the two-stream instability. Due both to the low phase velocity of the unstable waves and to their subsequent non-linear collapse, ions are accelerated to very high energies. This process is suggested as a possible explanation for experimentally observed collective ion acceleration by electron beams. (auth)

10097 Collisions in multi-dimensional plasma simulations. Matsuda, Y.; Okuda, H. (Plasma Physics Laboratory, Princeton University; Princeton, New Jersey 08540). *Phys. Fluids*; **18**: No. 12, 1740-1747(Dec 1975).

Collisions in multi-dimeniosnal plasma simulation models using finite-size particles are studied numerically and analytically. Drag and diffusion of particles in velocity space are measured and are compared with the theoretical predictions for two-, two-and-a-half-, and three-dimensional models. For two- and three-dimensional models, the measurement agrees reasonably well with the Balescu—Lenard theory. For the two-and-a-half-dimensional model, it is shown that the collisions strongly depend on the choice of the angle between magnetic field and wave vector due to the limited phase space available in the model. For a strongly magnetized plasma with Ω/subc/>ω/subp//subc/, the effective collisions are significantly reduced for a simulation plasma when aapproximately-greater-thanrho/subc/ (where a is particle size, and rho/subc/ is the gyroradius) in contrast to a real plasma where the effective collisions depend weakly on the magnetic field. (AIP)

PLASMA PRODUCTION

REFER ALSO TO CITATION(S) 9369

10098 Seeded megagauss turbulence in dense fusion-target plasmas. Tidman, D.A. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). *Phys. Rev. Lett.*; **35**: No. 18, 1228-1231(3 Nov 1975).

A collision-dominated inhomogeneous plasma seeded with a distribution of impurity grains is calculated to fill out rapidly with random megagauss fields for temperatures of about a kilovolt. Possible applications of this phenomenon (i) to enhance relativistic-electron-beam coupling to low-*Z* target plasmas, (ii) to influence transport coefficients, or (iii) to localize α-particle deposition in a reacting DT plasma are discussed. (AIP)

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 10069, 10096, 10111

10099 (MATT—1156) **Destabilization of the trapped electron mode by magnetic curvature drift resonances.** Adam, J.C.; Tang, W.M.; Rutherford, P.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 24p. Dep. NTIS $4.00.

Electron curvature drift resonances, ignored in earlier work on the trapped-electron modes, are found to exert a strong destabilizing influence in the lower collision frequency range of these instabilities. Effects arising from ion temperature gradients, shear, and finite ion gyroradius are included with these vector nebla-drifts in the analysis, and the resultant eigenvalue equation is solved by numerical procedures rather than the commonly used perturbation techniques. For typical tokamak parameters the maximum growth rates are found to be increased over earlier estimates by roughly a factor of 4, and requirements on magnetic shear strength for stabilization are likewise more severe and very difficult to satisfy. For inverted density profiles, this new destabilizing effect is rendered ineffective, with the result that the modes can be stabilized for achievable values of shear provided the temperature gradients are not too severe. Estimates of the particle and thermal energy transport are given for both normal and inverted profiles. (auth)

10100 (MATT—1199) **MHD equilibrium properties of tokamak fusion reactor designs.** Todd, A.M.M.; Gralnick, S.L.; Dalhed, H.E. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 25p. (CONF-751125—119). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The equilibrium properties of several Tokamak Reactor Designs are analyzed and compared for varying pressure and current profiles using the Princeton Equilibrium Code. It is found that the UWMAK configuration has a broader range of equilibria than the Princeton Reference Design configuration, but that the safety factor on axis is less than unity for peaked current distributions. The Argonne Experimental Power Reactor has a satisfactory range of equilibria, but a means of limiting or diverting the plasma has not yet been proposed, and this may substantially change the results obtained. (auth)

10101 (MATT—1200) **Some effects of parallel energy propagation on the structure of dissipative trapped electron modes.** Sauthoff, N.R. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 10p. Dep. NTIS $3.50.

The limitation of ballooning by parallel energy propagation is investigated for the dissipative trapped electron mode, wherein the local energy influx is proportional to the poloidally dependent trapped particle fraction. For small energetic asymmetries [mg less than 2.5 (Ω/sub i/a/c/sub s/) (a/R/sup $^3/_4$/] the structure along the field line is predominantly a phase shift, dictated by the condition that the asymmetric energy input be compensated by parallel energy flow. For large asymmetry, mode number, and parallel arc length, the phase and amplitude variations necessitate an integral equation treatment. (auth)

10102 (UCRL—51800) **Kink instabilities and the gas-embedded Z-pinch.** Hartman, C.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Apr 1975. Contract W-7405-Eng-48. 11p. Dep. NTIS $3.50.

A comparison of a previous gas-embedded Z-pinch experiment (by E. Smars) is made using a nonlinear theory of kink instability (by W. Manheimer, et al.). Good agreement is found for some experimental cases while for others the theory predicts too fast a growth of the kink. To account for this discrepancy the evolution of topologically different secondary currents is postulated. (auth)

10103 (ERDA-tr—106) **Several problems in the theory of tokamak microinstabilities.** Lominadze, D.G.; Mikhailovskii, A.B.; Tang, W.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. Translation of IAE—2584. 11p. Dep. NTIS $3.50.

Results of recent work on the theory of Tokamak microinstabilities are analyzed. Considerations are expressed as to which of the yet-unsolved problems of this theory are of interest as objects of research for the near future. (auth)

10104 (ERDA-tr—98) **Dynamic stabilization of helical modes of the plasma column by high frequency fields and a system of automatic control.** Demirkhanov, R.A.; Kirov, A.G.; Sidorovo, V.P.; Samoilenko, Yu.I.; Gubarev, V.F.; Krivonos, Yu.G. Translated from *Fiz. Plazmy*; 1: No. 5, 716-721(1975). 11p. Dep. NTIS $3.50.

Stability relative to perturbation of helical modes of a magnetized plasma column with a cross-sectionally homogeneous longitudinal current in the presence of a stabilizing high frequency field and an automatic regulating system is studied. The automatic regulating system may accept and amplify each space-time harmonic individually. The disperse equation and its analysis are described. (MOW)

10105 (ERDA-tr—97) **Instability of breakaway in tokamaks.** Kadomtsev, V.V. Translated from *Fiz. Plazmy*; 1: No. 5, 710-715(1975). 11p. Dep. NTIS $3.50.

The onset of the disruptive instability in tokamaks is discussed. A brief theory is presented for this instability. (MOW)

10106 MHD-stability of the Scyllac configuration. Berge, G.; Freidberg, J.P. (Los Alamos Scientific Lab., NM). pp 3-11 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

The results of a stability analysis for a diffuse high-β, $l = 1$ helical configuration are presented. It is shown that there exists a gross $m = 1$ mode whose properties are quite similar to those predicted by the sharp-boundary model. In addition, two new classes of $m = 1$ modes are found, one localized on the inside of the plasma, the other one outside. For any monotonic pressure profile, these modes are unstable although their growth rates are very small. A further study suggests that small changes in the profile may stabilize these modes. (auth)

10107 Plasma parameters and stability of the ZT-1 pinch experiment. Baker, D.A.; Burkhardt, L.C.; Di Marco, J.N. (Los Alamos Scientific Lab., NM). pp 35-45 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

The ZT-1 toroidal z-pinch experiment is designed to produce theoretically predicted MHD-stable equilibria with high-temperature plasmas. The equilibria are characterized by a hollow pressure profile and a strong toroidal stabilizing field inside the plasma; this field is programmed to reverse in the outermost region of the pinch. Experiments have been done with pinch current values of 30 to 200 kA with rise times of 2×10^{10} to 1.5×10^{12} A . s^{-1}. Ion temperature measurements have established the capability of a fast-rising toroidal current to heat ions to kilovolt temperatures. The streak pictures, plasma-density and magnetic-field measurements show that, for intermediate values of current rise-times, the plasma is well-confined, with small particle loss, for 10 to 12 μs. For this mode of operation, measurements on the plasma and field parameters show that appropriate field programming eliminates early unstable behavior. The rise-times of the poloidal and reversed toroidal fields need to be comparable in order to achieve the desired stable profiles. The electrons are observed to be colder than the ions and the measurements indicate that the stable time is limited by field diffusion. (auth)

10108 Effects of fluid instabilities on laser fusion pellets. Mead, W.C.; Lindl, J.D. (Lawrence Livermore Lab., CA). pp 27-52 of In Progress in lasers and laser fusion. Perlmutter, A. (ed.). New York; Plenum Press (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P2.

The discussions cover the following areas, code tests and anomalies, comparison with previous work, current understanding of fluid instability in the presence of ablation, and the implications of these results for laser fusion target design. (MOW)

10109 Magnetohydrodynamic stability of a sharp boundary model of tokamak. Freidberg, J.P.; Grossmann, W. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). *Phys. Fluids;* **18**: No. 11, 1494-1506(Nov 1975).

Calculations of critical β for a sharp boundary, constant pressure model of tokamak are presented. The analysis is valid for arbitrary β, arbitrary aspect ratio, and arbitrary plasma cross section. Specific results are given for the circle, ellipse, triangle, square, and doublet cross sections. (AIP)

10110 Kinetic theory of tearing instability. Hazeltine, R.D.; Dobrott, D.; Wang, T.S. (General Atomic Company, San Diego, California 92138). *Phys. Fluids;* **18**: No. 12, 1778-1786(Dec 1975).

The guiding-center kinetic equation with Fokker-Planck collision term is used to study, in cylindrical geometry, a class of dissipative instabilities of which the classical tearing mode is an archetype. Variational solution of the kinetic equation obviates the use of an approximate Ohm's law or adiabatic assumption, as used in previous studies, and it provides a dispersive relation which is uniformly valid for any ratio of wave frequency to collision frequency. One result of using the rigorous collision operator is the prediction of a new instability. This instability, driven by the electron temperature gradient, is predicted to occur under the long mean-free path conditions of present tokamak experiments, and has significant features in common with the kink-like oscillations observed in such experiments. (AIP)

PLASMA WAVE PHENOMENA

10111 (CONF-750356—) **Second international congress on waves and instabilities in plasmas, Innsbruck, Austria, March 17—21, 1975. Survey lectures.** Auer, G.; Cap, F. (eds.). (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). 1975. 288p. Innsbruck Univ., Austria.

From 2. international congress on waves and instabilities in plasmas "SICWIP"; Innsbruck, Austria (17 Mar 1975).

Separate abstracts were prepared for all 15 papers for inclusion in NSA. One of the 15 papers was abstracted and indexed in ERA. (WHK)

10112 Derivation of connection formulas for wave conversion in inhomogeneous plasma. Peratt, A.L. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Fluids;* **18**: No. 11, 1586-1587(Nov 1975).

Connection formulas relevant to the description of wave conversion in inhomogeneous plasma have been derived. (AIP)

10113 Phase locking the auto-resonant accelerator. Lohr, J. (Fusion Research Center, University of Texas at Austin, Austin, Texas 78712). *Phys. Fluids;* **18**: No. 12, 1822-1823(Dec 1975).

The normal development of the beam-plasma instability to a broadened fluctuation spectrum can be retarded by the injection of a plasma wave at the most unstable frequency. (AIP)

10114 Localized fields and density perturbations due to self-focusing of nonlinear lower-hybrid waves. Gekelman, W.; Stenzel, R.L. (Department of Physics, University of California, Los Angeles, California 90024). *Phys. Rev. Lett.;* **35**: No. 25, 1708-1710(22 Dec 1975).

Large-amplitude lower-hybrid wave bursts at $\omega_0 > \omega$/subL//subH/ are excited from a grid and propagate into a density gradient perpendicular to B_0. The evolution of the internal rf fields and the plasma parameters is investigated. Above threshold localized field maxima appear (E/sub int/very-much-greater-thanE/sub appl/) and, simultaneously, strong density perturbations are formed. The nonlinear phenomena are interpreted by ponderomotive-force and space-charge separation effects. (AIP)

THERMONUCLEAR POWER PLANTS

10115 (BNL—20759) **Steady-state plasma and reactor parameters for elliptical cross section tokamaks with very large power ratings.** Usher, J.L.; Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). Jun 1975. 91p. Dep. NTIS $5.00.

In previous studies only circular cross section reactor plasmas were considered. The purpose of this research is to examine the effects of elliptical plasma cross sections. Several technological benefits have been determined. Maximum magnetic field strength requirements are 30 to 65 percent less than for 5000 MW (th) reactors and may be as much as 40 percent less than for circular cross section reactors of comparable size. Very large n tau values are found (10^{15} to 10^{17} sec/cm^3), which produce large burn-up fractions (15 to 60 percent). There is relatively little problem with impurity build-up. Long confinement times (60 to 500 seconds) are found. Finally, the elliptical cross section reactors exhibit a major toroidal radius reduction of as large as 30 percent over circular reactors operating at comparable power levels. (auth)

10116 (ERDA—106) **Report of the Ad Hoc Committee on fusion plasma research facilities.** (Energy Research and Development Administration, Washington, D.C. (USA)). [nd]. 36p. Dep. NTIS $4.00.

This report surveys the need for Fusion Plasma Research Facilities (FPRF) in advancing research in several areas of plasma and atomic physics that are essential to the CTR program and describes several device options for FPRF's. The major conclusions of the report are that there is an urgent need to provide such facilities and that the most significant contributions to CTR that would be made through these facilities are in the development of plasma diagnostics and measurements of atomic processes. (auth)

10117 (STI/PUB—381(Vol.3)) **Plasma physics and controlled nuclear fusion research. Volume III. Proceedings series. Proceedings of the fifth international conference held in Tokyo, Japan, November 11—15, 1974.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1975. 722p. (In several languages). (CONF-741105—P3). IAEA $44.00.

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Separate abstracts for the 56 included papers appear in NSA. Abstracts for 22 of the papers appear in ERDA Research Abstracts. (MOW)

10118 FUSION REACTOR PHYSICS: PRINCIPLES AND TECHNOLOGY. Kammash, T. Ann Arbor, MI; United States of America (USA); Ann Arbor Science Publishers, Inc. (1975). 506p. $29.50.

Questions regarding the feasibility of fusion power are examined, taking into account fuel cycles and breeding reactions, energy balance and reactor conditions, approaches to fusion, magnetic confinement, magnetohydrodynamic instabilities, microinstabilities, and the main technological problems which have to be solved. Basic processes and balances in fusion reactors are considered along with some aspects of the neutronics in fusion reactors, the physics of neutral beam heating, plasma heating by relativistic electrons, radiofrequency heating of fusion plasmas, adiabatic compression and ignition of fusion reactors, dynamics and control of fusion reactors, and aspects of thermal efficiency and waste heat. Attention is also given to fission-fusion hybrid systems, inertial-confinement fusion systems, the radiological aspects of fusion reactors, design considerations of fusion reactors, and a comparative study of the approaches to fusion power. (IAA)

10119 Major design features of the conceptual D—T tokomak power reactor, UWMAK-II. Conn, R.W.; Kulcinski, G.L.; Abdou, M.A. (Univ. of Wisconsin, Madison). pp 497-509 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

The conceptual design of a 5000 MW(th) (approximately 1700 MW(e)) helium-cooled tokamak fusion reactor is presented. The fuel is deuterium and tritium and the structural material is 316 stainless steel. The design has a low aspect ratio (2.6) and low toroidal field on axis (35.7 kG) with 24 extended "D"-shaped superconducting TF coils. A superconducting air core transformer is designed with windings outside TF coils while the vertical field magnets, also superconducting, are inside the extended "D's". The plasma operating conditions have been determined using pessimistic scaling laws resulting from the trapped-ion instability. Such scaling can be beneficial in the reactor regime. A double-null poloidal field divertor is included for impurity control and a two-dimensional woven carbon cloth mounted on the vacuum chamber wall is included to protect the plasma from high-Z impurities and the first structural wall from erosion by charged-particle bombardment. The helium-cooled blanket contains solid Be in canned rods for neutron multiplication and solid lithium aluminate, also in canned rods, for tritium breeding. The breeding ratio is 1.19, the energy per fusion is 21.56 MeV, and the tritium inventory in the blanket is low, 42 g. Radiation damage problems are similar and as serious as those found in our previous study. Periodic replacement of blanket modulesevery two years will probably be required because of radiation damage. A detailed mechanism for blanket removal that does not require removal of the shield or the VF and TF coils is presented. (auth)

10120 Princeton reference design fusion power plant. Price, W.G. Jr. (Princeton Univ., NJ). pp 525-533 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

The Princeton Reference Design Fusion Power Plant is an electrical generating station based upon a large tokamak confining a D-T plasma. The plasma major and minor radii are nominally 10.5 m by 3.2 m; the toroidal field at the center-line is 6 T. With a mean ion temperature of 30 keV, an average β of 0.04, and an average tau of 3.83 s a fusion power of 3440 MW is achieved during 97 minutes of the 100 minute long-pulse cycle. The plasma throughput of 2.8 x 10^{22} ions/s is deflected down a divertor channel where it cools by radiation and is neutralized, exhausting as hot gas to the vacuum pumps. The total thermal power of 5305 MW is carried by a helium coolant to a conventional steam cycle producing 2030 MW(e) net. Tritium is bred in an 80-cm thick blanket of eutectic flibe (53.1 percent beryllium fluoride and 46.9 percent lithium fluoride) with Nimonic PE-16 (43 percent nickel, 39 percent iron, 18 percent chromium) as the structural material; the blanket-averaged volume fractions are 69.8 percent flibe, 9.4 percent PE-16, and 20.8 percent helium. The breeding ratio of 1.4 will allow doubling of the 2.57 kg inventory in 121 days. The nominal wall load of 1.76 MW of DT neutrons per m^2 implies a total flux of 8.65 x $10^{18} n.m^{-2}.s^{-1}$ at the wall and a corresponding helium production rate of 275 ppM/year. (auth)

10121 Two-energy-component toroidal fusion devices. Berk, H.L.; Furth, H.P.; Jassby, D.L. (Univ. of California, Livermore). pp 569-580 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

Injection of a superthermal ion component into a toroidal plasma can raise the fusion power density to levels considerably higher than those attainable in ordinary one-component plasmas. As a result, energy break-even in D-T can be attained in bulk plasmas with ntau-values as low as 10^{13} $cm^{-3}.s$, at temperatures of approximately 5 keV. The optimal energy of the superthermal ion component is in the range 100 to 200 keV; injection-energy requirements can be reduced by adiabatic compression prior to or during the reaction phase. The appropriate ratio anti GAMMA of fast-ion pressure to bulk-plasma pressure is about 0.5. The stability of two-component tokamak plasmas was examined, and is found to be favorable for parameters of practical interest. (auth)

10122 Conceptual design of a mirror reactor for a fusion engineering research facility (FERF). Batzer, T.H.; Burleigh, R.C.; Carlson, G.A. (Univ. of California, Livermore). pp 593-604 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

A conceptual design is presented for a small mirror fusion reactor for a Fusion Engineering Research Facility (FERF). The reactor produces 3.4 MW of fusion power and a useful neutron flux of about 10^{14} $n.cm^{-2}.s^{-1}$. Superconducting "yin-yang" coils are used, and the plasma is sustained by injection of energetic neutral D^0 and T^0. Conceptual layouts are given for the reactor, its major components, and supporting facilities. (auth)

10123 Engineering design of a fusion test reactor (FTB) and fusion engineering research facility (FERF) based on a toroidal theta pinch. Abdou, M.; Burke, R.J.; Dauzvardis, P.V. (Argonne National Lab., IL). pp 605-616 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

This paper describes two advanced toroidal theta-pinch devices which are being proposed for future construction. The Fusion Test Reactor (FTR) is being designed to produce thermonuclear energy (at 20 MeV/neutron) equal to the maximum plasma energy (Q = 1) and to demonstrate α-particle heating. The Fusion Engineering and Research Facility (FERF) is being designed to test materials in a fusion environment where the average 14-MeV neutron flux from the plasma is greater than or equal to 5 x 10^{13} $n/cm^2.s$ over large surface areas. These devices employ the staged theta-pinch principle where the heating is accomplished by rapid (approximately 0.1 μs) implosion and expansion followed by a slow compression of the plasma. The rapid implosion injects as much heat as possible at as large a plasma radius as possible so that the plasma remains stable even after further compression. The final compression to ignition requires the transfer of a large amount of magnetic energy which implies a long transfer time (approximately 1 ms) for realistic voltages in the driving circuit. Throughout the heating and burn cycle the plasma must remain in equilibrium and stable to the dominant MHD-modes. A sufficiently large plasma radius guarantees stability against the m = 1 modes. These equilibrium and stability conditions and the requirements on thermonuclear burn determine the design parameters for either machine. The design parameters must also be consistent with economic limitations and technological feasibility of components. In addition to these requirements, the FERF must provide a steady and reliable source of fusion neutrons. (auth)

10124 (ERDA-tr—66, pp 19-34) **Developments related to construction of tokamak-based thermonuclear reactors.** Golovin, I.N. (Inst. of Atomic Energy, Moscow). Oct 1975. Translation of Russian paper.

In Selected USSR papers on plasma physics and controlled thermonuclear fusion.

A design and some numerical calculations for a hybrid reactor containing uranium in the blanket are discussed with respect to its future use as an operating power plant. Some materials studies and technological developments are described. (MOW)

PHYSICS AND BLANKET ENGINEERING

10125 (BNL—20717) **Low activity blankets for experimental power reactors.** Benenati, R.; Fillo, J.; Lazareth, O.W.; Majeski, S.; Powell, J.R.; Tichler, P. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 20p. (CONF-751125—134). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Results of current studies aimed at the development of low activity blankets for Tokamak experimental power reactors are presented. First wall loadings in the range of 0.5 to 1.0 MW(th)/m² have been assumed. Blanket designs are developed for both circular plasma reactors (R = 6.25m, a = 2.1m) and non-circular plasma reactors (R = 4.0m, a = 1.0m, b = 3.0m). For each of these two reactor choices, two blanket options are described. 1) In the first option, the blanket is thick graphite block structure (approximately 50cm thickness) with SAP coolant tubes carrying helium imbedded deep within the graphite to minimize radiation damage. The neutron and gamma energy deposited in the graphite is radiated along internal slots to the coolant tubes where approximately 80 percent of the fusion energy is carried off by He at 380°C. The remaining 20 percent of the fusion energy is removed by a separate He stream at a slightly lower temperature. The maximum graphite surface temperature is relatively low (approximately 1700°C at 1 MW(th)/m2). 2) In the second blanket option, the blanket is composed of aluminum modules. The aluminum shell (5000 series alloy) is maintained at a low temperature (approximately 200°C) by a water coolant stream. Approximately 40 percent of the fusion energy is removed in this circuit. The remaining 60 percent of the fusion energy is deposited in a thermally insulated hot interior (SiC and B_4C) where it is transferred to a separate He coolant, with exit temperature of 700°C. (auth)

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 8970

10126 (BNL—20726) **Structural safety features for superconducting magnets.** Lehner, J.; Reich, M.; Powell, J.; Bezler, P.; Gardner, D.; Yu, W.; Chang, T.Y. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 19p. (CONF-751125—133). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A survey has been carried out for various potential structural safety problems of superconducting fusion magnets. These areas include: (1) Stresses due to inhomogeneous temperature distributions in magnets where normal regions have been initiated. (2) Stress distributions and yield forces due to cracks and failed regions. (3) Superconducting magnet response due to seismic excitation. These analyses have been carried out using a variety of large capacity finite element computer codes that allow for the evaluation of stresses in elastic or elastic-plastic zones and around singularities in the magnet structure. Thus far, these analyses have been carried out on UWMAK-I type magnet systems. (auth)

10127 (BNL—20752) **Summary of existing superconducting magnet experience and its relevance to the safety of fusion magnet.** Hsieh, S.Y.; Allinger, J.; Danby, G.; Keane, J.; Powell, J.; Prodell, A. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 6p. (CONF-751125—132). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A comprehensive summary of experience with over twenty superconducting magnet systems has been collected through visits to and discussions about existing facilities including, for example, the bubble chamber magnets at Brookhaven National Laboratory, Argonne National Laboratory and Fermi National Accelerator Laboratory, and the large superconducting spectrometer at Stanford Linear Accelerator Center. This summary includes data relating to parameters of these magnets, magnet protection methods, and operating experiences. The information received is organized and presented in the context of its relevance to the safe operation of future, very large superconducting magnet systems for fusion power plants. (auth)

10128 (CONF-751125—99) **Test facility for PLT TF coils.** Hearney, J.; File, J.; Dreskin, S. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 6p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Past experience with the model C stellerator and other toroidal field devices indicates that mechanical and electrical tests of a toroidal field coil prior to maximum field operation of the device is prudent and desirable. This paper describes a test program for the PLT-TF coils. The test stand consists of one test coil, two background coils and a steel supporting structure. The three coil configuration produces a 67.5 kG field at the inner conductor (38 kG at the bore center) and simulates a 1/R field distribution in the bore of the test coil. The resolution of the field force system and resultant stresses within the test structure are discussed. A test procedure is described which maximizes the information obtained from a 100,000 pulse program. (auth)

10129 (CONF-751125—100) **Center column design of the PLT.** Citrolo, J.; Frankenberg, J. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 3p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The center column of the PLT machine is a secondary support member for the toroidal field coils. Its purpose is to decrease the bending moment at the nose of the coils. The center column design was to have been a stainless steel casting with the toroidal field coils grouped around the casting at installation, trapping it in place. However, the castings developed cracks during fabrication and were unsuitable for use. Installation of the coils proceeded without the center column. It then became necessary to redesign a center column which would be capable of installation with the toroidal field coils in place. The final design consists of three A-286 forgings. This paper discusses the final center column design and the influence that new knowledge, obtained during the power tests, had on the new design. (auth)

10130 (CONF-751125—101) **Toroidal field coils for the PDX machine.** Bushnell, C.W. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 2p. (CONF-751063—2). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper describes the engineering design features of the TF coils for the PDX machine. Included are design details of the electrical insulation, water cooling, and coil segment joint which allows access to the central machine area. A discussion of the problems anticipated in the manufacture and the planned solutions are presented. (auth)

10131 (CONF-751125—102) **Analyses of laminated beams for us in coil design.** Bialek, J. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 13p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Recent experimental data obtained from PLT has shown that equivalent beam theory is inadequate for predicting the deformation of large circular toroidal field coils. The PLT coils are much more flexible than equivalent beam theory predicts. The latest analyses have shown that shear plays an important role in the deformation of the PLT TF coils. This situation has indicated the need to analyze in explicit detail, the layer to layer behavior of simple laminated structures. The progress made to date in analyzing a laminated beam is summarized. By using variational techniques, the deflections and stresses in each layer of a laminated beam are modeled. To date, reasonable results have been obtained for either deflection or stress separately but a single model that simultaneously gives good agreement for both deflection and stress has not yet been determined. Brief descriptions of the mathematical models used and the results obtained with each are presented. (auth)

10132 (CONF-751125—104) **Stress analysis of PLT coil.** Frankenberg, J.; Smith, R.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.; Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1975. 13p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The toroidal field coils of tokamak devices create a field within the torus whose strength varies inversely with distance from the machine center. This field, crossing the current in the TF coils, creates a magnetic pressure on the coil. The pressure produces a net inward centering force, countered by pressure on the wedge face, and a vertical separating force, causing tensile stress across the horizontal mid-plane. In the past these forces have been analyzed by superposition and beam theory. Because of the size and complexity of the PLT machine it was decided to also initiate a finite element analysis of the coil. This paper describes both methods of analysis. (auth)

10133 (CONF-751125—122) **Analytical solution of the toroidal constant tension solenoid.** Gralnick, S.L.; Tenney, F.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 5p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The coil shape is determined by requiring that the curvature of the flexible conductor be proportional to the distance from the toroidal axis. The resulting second order differential equation for the coil coordinates can be integrated once but for the second and final integration no closed form has been found and the integration has been done numerically. This solution of this differential equation is analytical in terms of an absolutely and uniformly convergent infinite series. The series converges quite rapidly and in practice ignoring all but the first five terms of the series introduces an error of less than 2 percent. (MOW)

10134 (CONF-751125—125) **Energy system for the generation of divertor magnetic fields in the PDX fusion research device.** Turitzin, N.M. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 6p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

One of the major problems encountered in the development of Tokamak type fusion reactors is the presence of impurities in the plasma. The PDX device is designed to study the operation of poloidal magnetic field divertors and consequent magnetic limiters for controlling and reducing the amount of impurities. A system of coils placed at specific locations produces a required field configuration for the poloidal divertor. This paper describes the system of energy supplies required and the interrelations of field coil currents during plasma current initiation, growth and steady state. (auth)

10135 (GA-A—13668) **Stress analysis of Doublet III toroidal coil.** Reis, E.E.; Charman, C.M.; Feuerbacher, R.L.; Puhn, F.A.; Wesley, J.C. (General Atomic Co., San Diego, Calif. (USA)). 3 Oct 1975. Contract E(04-3)-167. 18p. Dep. NTIS $3.50.

The toroidal field coil (B-coil) in the Doublet III Tokamak consists of 144 turns, each carrying 195 kA, grouped in 24 bundles of six turns each. The bundles are collectively bonded together near the toroid centerline to form one composite centerpost. The results of the stress analysis of the B-coil show that it is structurally adequate for 100,000 cycles of operation under loading conditions produced by a 40 kG toroidal field. (auth)

10136 (GA-A—13687) **Design of demountable joint for Doublet III toroidal field coil.** Puhn, F.A.; Callis, R.W.; Jones, J.D.; Reis, E.E.; Wesley, J.C. (General Atomic Co., San Diego, Calif. (USA)). 3 Oct 1975. Contract E(04-3)-167. 13p. (CONF-751125—121). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The design criteria for General Atomic Company's Doublet III Tokamak specifies a demountable joint at the top of the toroidal field coil (B-coil). This joint allows assembly of the vacuum vessel, electric field coils (E-coils), field-shaping coils (F-coils), and supporting structure without any joints in these components. The overall design and assembly sequence of Doublet III is therefore critically dependent on proper functioning of the B-coil demountable joint. The selected interlocking finger design incorporates sufficient strength and electrical conductivity to permit operation at a toroidal field of up to 40 kG for 10^5 cycles with an adequate margin of safety. The finger joint can be manufactured using standard machining tolerances and procedures and can be assembled and disassembled with relative ease and rapidity. (auth)

10137 (MATT—1168) **Magnetic braiding due to weak asymmetry.** Rechester, A.B.; Stix, T.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 16p. Dep. NTIS $3.50.

Magnetic surfaces for a plasma with a helical current perturbation approximately epsilon^2 are destroyed by toroidal effects or by a second current perturbation, of incommensurate helicity, and the behavior of magnetic field lines becomes stochastic in layers of relative width epsilon$^-$/sup l/exp (-π/2 epsilon). (auth)

10138 (MATT—1197) **Analytic solutions for constant tension coil shapes.** Gralnick, S.L.; Tenney, F.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 30p. Dep. NTIS $4.00.

An analytical solution of the differential equation describing the shape of a flexible filamentary conductor (incapable of supporting bending stresses) in a toroidal magnetic field has been obtained. The solution derives from a series expansion of modified Bessel functions of integer order. The characteristics of toroidal field magnets for proposed tokamak devices are obtainable by term by term integration of the solution series. General expressions are given for the following coil characteristics: the conductor turn length, the solenoid inductance, the area enclosed by the coil and the coil support dimensions. For several particular cases of interest these coil characteristics are obtained as closed form analytical formula. (auth)

10139 (UCCND-CSD-INF—56) **Magnetic field of a flat coil of rectangular cross section and arbitrarily shaped border.** Whitson, J.C.; van Rij, W.I.; Clark, B.A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 19p. Dep. NTIS $5.00.

A subroutine was written that calculates the magnetic field due to current flowing in a coil of finite rectangular cross-section. The coil lies in a plane and may take any shape except one where a multivalued function is necessary to describe the path of the current. (auth)

10140 (ERDA-tr—86, pp 1-16) **Availability of superconducting technology for fusion research.** Komarek, P. (Institute for Experimental Nuclear Physics, Karlsruhe, Ger.). Jan 1975. Translated from German report.

In Reports of the Nuclear Research Center, Karlsruhe. 7th annual publication.

The magnet system for the tokamak is described with respect to plasma confinement, diverters, and the coil system. Dimensioning of the poloidal and toroidal field coils is discussed. The design of a superconducting coil for energy storage is given. (MOW)

POWER SUPPLIES AND CIRCUITRY

10141 (CONF-751125—117) **Fault protection for neutral-beam injection systems.** Knauer, R.C.; Ashcroft, D.L.; Murray, J.G.; Newman, R.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 4p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper concerns the design of a circuit to control the accelerating voltage to a neutral injection gun. An ignitron crowbar is used to dissipate stored energy in the event of an arc-over in the ion gun. (auth)

10142 (CONF-751125—128) **PLT bias fields and their current supplies.** Kloiber, F.W. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 6p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Two mutually perpendicular bias fields provide vernier control over the plasma location in the vacuum chamber. A radially outward horizontal field is generated by a separate set of two bias coils mounted horizontally above and below the vacuum chamber and connected in series opposing. The vertical bias field is generated by superimposing a bias current on the main vertical field or shaping field coils. A forward or aiding bias field is generated by simply programming an incremental forward current into the main shaping field supply. For a reverse bias field, however, a reverse current supply is required which must establish negative bias current in the shaping field coil prior to the plasma formation. After plasma formation, as the plasma current increases and induces a forward voltage in the field coil, the bias current goes to zero. When the coil current goes positive, the reverse bias supply is taken out of the circuit to prevent it from acting as a short circuit across the SF coil. (auth)

10143 (CONF-751125—131) **High Power Modulator/regulators for neutral beam sources.** Lawson, J.Q.; Deitz, A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 10p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

PPPL has recently completed two new Modulator/Regulators for neutral injection sources used on the ATC machine and is constructing four new ones for use with sources on the PLT machine. The ATC modulator uses the well proven 4CX35,000C tetrode as the main switch tube, while the PLT modulators will be using the new but significantly higher powered X-2170 tetrodes. Some interesting circuit and manufacturing techniques are discussed. (MOW)

10144 **Fundamental limitations and topological considerations for fast discharge homopolar machines.** Driga, M.D.; Nasar, S.A.; Rylander, H.G. (Univ. of Texas, Austin). *IEEE Trans. Plasma Sci.*; **PS-3**: No. 4, 209-215(Dec 1975).

Fusion research experiments require high energy short duration pulses. A homopolar machine, as an inertial energy storage system, offers an attractive source of energy meeting these requirements. The Energy Storage Group at the University of Texas at Austin has investigated the fundamental limitations to the discharge time of homopolar machines of various topological configurations. This paper presents a mathematical model for fast discharge homopolar machines. Based on this model, various machine configurations are analyzed. A new configuration—the spool type machine—is also discussed, criteria for the evaluation of different alternatives are presented, and it is concluded that highly efficient (approximately equal to 95 percent), high energy (approximately equal to gigajoules), fast-discharge (approximately equal to 5 to 30 milliseconds) homopolar inertial energy storage systems are technically feasible. Brief reference is also made to some of the experimental results obtained from the existing laboratory models. (auth)

FUEL SYSTEMS

10145 (CONF-751125—136) **Energy spectra of fusion neutrons from plasmas driven by reacting ion beams.** Towner, H.H.; Jassby, D.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 5p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Neutron spectra are calculated for two-component tokamak reactors using appropriate steady-state velocity distributions for fast deuterons. The angle-averaged neutron spectra are shown for D-T and D-T interactions. (MOW)

10146 **Interesting possibilities of fusion—fission.** Werner, R.W. (Univ. of California, Livermore); Lee, J.D.; Moir, R.W.; Carlson, G.A.; Peterson, M.A.; Wolkenhauer, W.C.; Leonard, B.R. Jr. pp 641-648 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

The hybrid reactor, a fusion plasma source driving a subcritical fission assembly, is discussed. Hybrids combine neutron-rich but power-poor fusion, with power-rich but neutron-poor fission. Hybrids may be realizable before pure fusion since they substantially relax the plasma and engineering requirements. A fissile blanket could be designed with one or more of the following primary goals: energy amplification on a power reactor, production of fissile fuel, and/or an interim system in the development of pure fusion. Lawrence Livermore Laboratory and Pacific Northwest Laboratory have undertaken several hybrid studies including fast fission blankets, thermal blankets, and fusion systems with power production as the primary goal. Present blanket studies have concentrated largely on neutronic performance, and energy multiplication in the 7 to 40 range has been demonstrated. Beyond the ability of the blanket to energy-multiply, it is necessary that many other design requirements be satisfied, such as structural, heat transfer and economics. Accessibility of the blanket for servicing is very important. System components other than the blanket must also be considered. A complete design study to determine whether the hybrid can be economically competitive and environmentally acceptable in a time period that precedes pure fusion has been begun by the authors. (auth)

10147 **Progress toward the development of a mirror hybrid (fusion—fission) reactor.** Leonard, B.R. Jr.; Wolkenhauer, W.C. (Pacific Northwest Labs., Richland, WA). pp 649-655 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

Pacific Northwest Laboratories (PNL), in cooperation with Lawrence Livermore Laboratory, has been studying a hybrid (fission-fusion) reactor based on a mirror magnetic confinement device. The fissile-blanket concept, based on a depleted uranium convertor and a slightly enriched uranium High Temperature Gas Cooled Reactor technology, has been developed at PNL. Using the DT plasma constraints and systems analysis primarily performed at LLL, the authors previously had reported the results of initial-condition neutronics calculations. These results projected a viable electrical power plant with 2000 MW(th) developed in the blanket, 680 MW(e) net, and probable breeding of both thermally fissile material and tritium in a subcritical fission blanket. In this paper, the authors report on the results of neutronics calculations performed through a 200-day operating period. These results confirm the performance characteristics originally proposed and, in fact, predict a larger average blanket energy multiplication and more positive fissile and tritium breeding over the operating period. The calculations also demonstrate the necessity of performing calculations during burn-up, at operating temperature, to obtain reliable performance parameters. In addition the paper reports on a minor design change, on the sensitivity of the calculated performance to ^{238}U data deficiencies, and a preliminary assessment of the importance of the broad source neutron energy spectrum of the mirror in the neutronics analysis. (auth)

RADIATION HAZARDS

10148 (MLM—2292) **Tritium interactions of potential importance to fusion reactor systems: technology requirements.** Wilkes, W.R. (Mound Lab., Miamisburg, Ohio (USA)). 15 Jan 1976. Contract E-33-1-Gen-53. 18p. Dep. NTIS $4.00.

The tritium technology requirements created by the controlled thermonuclear research program to develop a demonstration fusion power reactor by the year 2000 are reviewed. It is found that the majority of the technological advances which are needed to ensure adequate tritium containment in a tritium breeding power reactor need to be demonstrated on a pilot scale by approximately 1983, so that they may be incorporated into EPR-II, the second of two planned experimental power reactors. The most important advances include development of containment materials with permeabilities to tritium well below measured values for stainless steel; large scale, low inventory deuterium-tritium separation systems; and improved monitoring and assay systems. There are less critical requirements for information about the effects of tritium and helium on the mechanical properties of materials, the effects of tritium on biological systems, and data on physical and chemical properties of tritium. Substantial progress needs to be made on these problems early enough to permit possible solutions to be tested on EPR-I. In addition, major improvements in tritium handling equipment are required for EPR-I. Those technological problems for which solutions have not yet been demonstrated by EPR-II must be solved by 1989 if they are to be assured successful application in the demonstration reactor. (auth)

10149 (ORNL—5046, pp 96-99) **Health physics aspects of fusion power.** Easterly, C.E.; Shoup, R.L.; Poston, J.W.; Booth, R.S.; Clark, F.H. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Radiation exposure to the general population due to the operation of controlled thermonuclear reactors is estimated based on current information. Topics covered include: neutron activation products, localized tritium behavior and global tritium circulation. (GHT)

10150 (ORNL-TM—5080) **Scoping studies of tritium handling in a tokamak experimental power reactor.** Watson, J.S.; Cherdack, R.; Clinton, S.D.; Fisher, P.W. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 50p. Dep. NTIS $5.50.

Tritium handling techniques in an experimental fusion power reactor (EPR) are evaluated to determine the requirements of the system and to compare different equipment and techniques for meeting those requirements. Tritium process equipment is needed (1) to evacuate and maintain a vacuum in the plasma vessel and the neutral beam injectors, (2) to purify and recycle tritium and deuterium for the plasma fuel cycle, (3) to recover tritium from experimental breeding modules, and (4) to provide tritium containment and atmospheric cleanup. A development program is outlined to develop and demonstrate the required techniques and equipment and to permit confident design of an EPR for operation by the mid-1980s. (auth)

10151 (SAND—74-8682) **Tritium removal: a preliminary evaluation of several getters.** Schoenfelder, C.W.; West, L.A. (Sandia Labs., Livermore, Calif. (USA)). Nov 1975. Contract AT(29-1)-789. 34p. Dep. NTIS $4.00.

The removal of hydrogen isotopes from flowing gas streams is an important aspect of CTR technology for both decontamination and tritium recovery from plasma exhausts. Several getters have been evaluated for their tritium scrubbing potential at the parts per billion level. Measurements of total capacity and dynamic response have been made for barium, erbium, palladium dispersed on molecular sieve, General Electric H-36 (zirconium alloy), Union Carbide Y-993 ($PdMnO_3$), Societa Apparecchi Electtrici e Scientifici Getters ST101 (Zr—Al), ST171, and ST181, and a Sandia developed organic material, dimerized phenyl propargyl ether (DPPE). Preliminary flow studies were conducted by passing mixtures of either hydrogen or deuterium diluted with argon through packed beds containing the getter and periodically sampling the effluent with a gas chromatograph sensitive to 500 ppB H_2. The results of this work, similar flow experiments using tritium and total capacity measurements are presented in the text. (auth)

POWER CONVERSION SYSTEMS

10152 (BNL—20716) **Implications of high efficiency power cycles for fusion reactor design.** Powell, J.R.; Usher, J.; Salzano, F.J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 19p. (CONF-751125—137). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The implications of the High Efficiency Power Cycle for fusion reactors are examined. The proposed cycle converts most all of the high grade CTR heat input to electricity. A low grade thermal input (T approximately 100°C) is also required, and this can be supplied at low cost geothermal energy at many locations in the U. S. Approximately 3 KW of low grade heat is required per KW of electrical output. The thermodynamics and process features of the proposed cycle are discussed. Its advantages for CTR's are that low Q machines (e.g. driven Tokamaks, mirrors) can operate with

a high (approximately 80 percent) conversion of CTR fusion energy to electricity, where with conventional power cycles no plant output could be achieved with such low Q operation. (auth)

10153 (CONF-751125—91) **Proposed TFTR electrical system.** Bronner, G.; Murray, J. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 13p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The development of controlled thermonuclear fusion has progressed to the stage where the present facilities and energy available for future devices are not sufficient and must be increased by about a factor of ten. This report describes the proposed TFTR ac utility power distribution system, an energy storage motor generator flywheel facility, and the rectifier conversion equipment for the Toroidal Field Confining System (TF), Ohmic Heating System (OH), Equilibrium Field System (EF) and the Neutral Beam Heating System (NB). The general requirements are described and the special design considerations identified. (auth)

10154 (UCID—16985) **Some considerations in the design of a Venetian Blind direct converter.** Barr, W.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $3.50.

The structural design of a Venetian Blind direct converter will depend on the choice, for example, of: 1) Expander field, (2) Selective leakage, (3) Number of collector stages, (4) Method of cooling and (5) The general configuration and orientation. This note is intended to outline the major compromises that will result from the variation of parameters to fit a particular design. The relationships given are for a two-stage unit, but it is straightforward to extend them to multiple-stage units. (auth)

10155 Direct conversion of plasma energy to electricity for mirror fusion reactors. Moir, R.W.; Barr, W.L.; Carlson, G.A. (Univ. of California, Livermore). pp 583-592 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

Direct conversion of both plasma and ion beam energy to electricity for mirror fusion reactors is described. Selective leakage, magnetic expansion, electron separation, deceleration, and collection of ions are discussed. An experiment testing all processes except selective leakage gave an overall efficiency of 86.5 +- 1.5 percent for a 22-stage collector. Computer calculations of these same processes gave an efficiency of 88.6 +- 1.5 percent, considered excellent agreement. Experiments on a two-stage collector gave 65 percent efficiency compared to 69 percent calculated efficiency. One-, two-, and 22-stage converters were studied under reactor-like conditions with a large computer simulation code that accounts for space charge, secondary electrons, and finite, realistic electrode shapes. The converters' efficiencies are estimated to be 48 percent, 58 percent and 63 percent, respectively. The efficiencies under the assumed reactor conditions are lower than under controlled laboratory conditions (86.5 percent). The one-stage converter is more cost-effective than the two-stage converter, which, in turn, is more cost-effective than the 22-stage converter; although more collector stages give higher efficiency, the simpler converters can handle more power. Conversely, if higher efficiency were desired, the studies show that it can always be achieved—but at a price. Laboratory tests of mono-energetic beam direct conversion gave 96 percent efficiency for a 2-keV low power d.c. beam and 70 percent for a d.c. 20 keV, 1-kW beam. The same computer code mentioned above is being used to design practical direct converters that reduce power requirements of neutral-beam injectors in the 100 to 200-keV range. (auth)

INERTIAL CONFINEMENT SYSTEMS

REFER ALSO TO CITATION(S) 9241, 10055, 10059

10156 PROGRESS IN LASERS AND LASER FUSION. CONFERENCE HELD IN CORAL GABLES, FLORIDA, JANUARY 20—24, 1975. Perlmutter, A.; Widmayer, S.M. (eds.). Studies in the Natural Sciences, Volume 8. New York; United States of America (USA); Plenum Press (1975). 416p. (CONF-750110—P2). $35.00.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

Separate abstracts were prepared for the eleven papers. (MOW)

10157 (UCRL—77139) **Comparison of LASNEX calculations with experimental results of parylene disc irradiations at 1.06 μm.** Mead, W.C.; Kruer, W.L.; Lindl, J.D.; Shay, H.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1975. Contract W-7405-Eng-48. 16p. (CONF-751130—14). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Calculations are discussed using the 2D Lagrangian code LASNEX to simulate irradiation of Parylene discs. Using a representation of the experimental beam profile, geometric optics propagation, and an absorption model based on plasma simulations, the scattered light angular intensity distribution can be obtained. The use of a suprathermal electron heating spectrum and thermally generated magnetic fields with Braginskii transport coefficients leads to agreement with time-integrated x-ray spectra and x-ray spatial distributions. Details of the calculations and comparisons with other models are discussed. (auth)

10158 Progress on CO_2 laser gas fusion. Vlases, G.C. (Univ. of Washington, Seattle); Rutkowski, H.; Hertzberg, A. pp 197-206 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

Experimental and theoretical investigations were carried out on the interaction of CO_2-laser radiation with underdense plasma (10^{17} to 5 x 10^{18} cm^3) in strong magnetic fields with the aim of determining feasibility of this approach to CTR. The efforts of three groups, University of Washington—Mathematical Sciences, MIT—Avco, and Princeton are reported. The experiments show that the theoretically predicted self-focusing of the beam in the plasma is effective. Shock waves and bleaching waves have been observed. Theoretical calculations of thermonuclear yields show that large gains are possible from this type of reactor. (auth)

10159 Self-focusing and filamentation of laser light in plasmas. Lee, Y.C. (Univ. of California, Los Angeles); Liu, C.S.; Chen, H.H.; Nishikawa, K. pp 207-215 of In Plasma physics and controlled nuclear fusion research, 1974. Vol. III. Vienna; International Atomic Energy Agency (1975).

From 5. conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

See STI/PUB—381(Vol.3); CONF-741105—P3.

The diffraction threshold and focal length of a self-focusing laser beam in plasma are derived. A self-similar solution is obtained to describe analytically the spatial structure of the self-focusing process. The filamentation instability is also discussed with the effect of plasma inhomogeneity included. (auth)

10160 Experiments in laser fusion. Hofstadter, R. (Stanford Univ., CA). pp 71-104 of In Progress in lasers and laser fusion. Perlmutter, A. (ed.). New York; Plenum Press (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P2.

Experiments are described that directly observe laser heating, target compression, and hydrodynamic heating. The observed neutron production is correlated with compressed targets and is consistent with core temperatures of 0.5 to 0.7 keV. These results substantially confirm some of the basic concepts of laser-driven fusion and provide strong encouragement to extend the experiments to higher laser energies and a larger class of fusion targets. (MOW)

10161 Outlook for laser fusion. Nuckolls, J.H. (Lawrence Livermore Lab., CA). pp 105-116 of In Progress in lasers and laser fusion. Perlmutter, A. (ed.). New York; Plenum Press (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P2.

A brief overview of the laser fusion program is given. The discussion covers significant results in the research program. (MOW)

10162 Scattered radiation and neutron production in laser-plasma interaction. Mascheroni, P.L. (Univ. of Texas, Austin). pp 281-308 of In Progress in lasers and laser fusion. Perlmutter, A. (ed.). New York; Plenum Press (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P2.

A theoretical study of the nonlinear and parametric interaction processes taking place during laser implosion of a deuterium-tritium microsphere is given. (MOW)

10163 Theory of powerful laser light propagation in a material medium. Lugovoi, V.N.; Prokhorov, A.M. (Lebedev Inst. of

Physics, Moscow). pp 309-407 of In Progress in lasers and laser fusion. Perlmutter, A. (ed.). New York; Plenum Press (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P2.

A multifoci picture is given that provides a consistent theory of high-power laser propagation in Kerr nonlinearity media and leads to the concept of moving foci. The theory is based on the Maxwell equations. (MOW)

10164 (ERDA-tr—66, pp 35-38) **Laser installations for heating dense plasmas.** Oct 1975. Translation of Russian paper.

In Selected USSR papers on plasma physics and controlled thermonuclear fusion.

A listing is given of research facilities for laser fusion studies. A brief discussion of each facility and some of the more important results obtained at each facility are presented. (MOW)

10165 Thermally generated magnetic fields in laser-driven compressions and explosions. Tidman, D.A. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **18**: No. 11, 1454-1459(Nov 1975).

The evolution of thermally generated magnetic fields in a plasma undergoing a nearly spherically symmetric adiabatic compression or expansion is calculated. The analysis is applied to obtain approximate results for the development of magnetic fields in a laser-driven compression and explosion of a pellet of nuclear fuel. Localized sources such as those occurring at composition boundaries in structured pellets or at shock fronts give stronger fields than those deriving from smoothly distributed asymmetries. Although these fields may approach 10^7 G in the late stages of compression, this is not expected to present difficulties for the compression process. Assuming ignition of a nuclear explosion occurs, the sources become much stronger and values of $\cong 10^{10}$ G are obtained at tamper boundaries assuming a 20% departure from spherical symmetry during the explosion. (AIP)

10166 Measurement of the development and evolution of shock waves in a laser-induced gas breakdown plasma. Chu, T.K.; Johnson, L.C. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). *Phys. Fluids;* **18**: No. 11, 1460-1466(Nov 1975).

Space- and time-resolved interferometric measurements of electron density in CO_2-laser produced plasmas in helium or hydrogen are made near the laser focal spot. Immediately after breakdown, a rapidly growing region of approximately uniform plasma density appears at the focal spot. After a few tens of nanoseconds, shock waves are formed, propagating both transverse and parallel to the incident laser beam direction. Behind the transverse propagating shock is an on-axis density minimum, which results in laser-beam self-trapping. The shock wave propagating toward the focusing lens effectively shields the interior plasma from the incident beam because the lower plasma temperature and higher plasma density in the shock allow strong absorption of the incident beam energy. By arranging the laser radiation-plasma interaction to begin at a plasma-vacuum interface at the exit of a free-expansion jet, this backward propagating shock wave is eliminated, thus permitting efficient energy deposition in the plasma interior. (AIP)

10167 Fusion—fission hybrid concepts for laser-induced fusion. Maniscalco, J. (Univ. of California, Livermore). *Nucl. Technol.;* **28**: No. 1, 98-107(Jan 1976).

Fusion-fission hybrid concepts are viewed as subcritical fission reactors driven and controlled by high-energy neutrons from a laser-induced fusion reactor. Blanket designs encompassing a substantial portion of the spectrum of different fission reactor technologies are analyzed and compared by calculating their fissile-breeding and fusion-energy-multiplying characteristics. With a large number of different fission technologies to choose from, it is essential to identify more promising hybrid concepts that can then be subjected to in-depth studies that treat the engineering safety, and economic requirements as well as the neutronic aspects. In the course of neutronically analyzing and comparing several fission blanket concepts, this work has demonstrated that fusion-fission hybrids can be designed to meet a broad spectrum of fissile-breeding and fusion-energy-multiplying requirements. The neutronic results should prove to be extremely useful in formulating the technical scope of future studies concerned with evaluating the technical and economic feasibility of hybrid concepts for laser-induced fusion. (auth)

COMPONENT DEVELOPMENT AND TESTING

REFER ALSO TO CITATION(S) 10149

10168 (ANL/CTR—75-3) **CTR quarterly progress report, July—September 1975.** (Argonne National Lab., Ill. (USA)). Nov 1975. Contract W-31-109-Eng-38. 97p. Dep. NTIS $6.50.

Research progress conducted during this period is reported for the following general areas: (1) surface studies, (2) materials, (3) tokamak experimental power reactor, (4) engineering technology, and (5) superconducting magnet program. (MOW)

10169 (BNWL—1939-1) **Pacific Northwest Laboratory report on controlled thermonuclear reactor technology, January 1975—September 1975.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. 91p. Dep. NTIS $5.45.

The PNL staff has been studying fusion technology in areas such as economics, fusion-fission hybrid concepts, materials, neutronics, environment and safety. These studies have been scoped to make efficient use of ERDA resources, and to complement and support efforts at other laboratories. The effect the plasma and associated radiation and emission will have upon the surfaces of the first wall are being studied. Neutron sputtering experiments were made on niobium and gold and the results were evaluated for absolute neutron yields. Molybdenum and vanadium were studied for effects of ion bombardment under various conditions of helium injection. Graphite cloth is being irradiated for examination of radiation effects because it is suggested for use in several CTR concepts as a shield between the plasma and the first wall. Helium effects are being studied to characterize degradation of structural metal properties. Work is progressing on absolute measurement of the electrical resistivity of insulators and the demonstration of the feasibility of producing insulating coatings by sputter deposition. (auth)

10170 (CONF-751125—90) **Fabrication of the PDX vacuum vessel.** Joyce, J.B.; Mullaney, D.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 4p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The vacuum vessel for PDX is designed to meet the three goals of large volume, simplicity and accessability. A shell of one half inch thick welded 305 stainless steel meets these requirements. The geometry of the tank is that of a stretched torus having a cross sectional shape of a race track. Access to the inside of the tank is available through man sized ports, removal of top or bottom, or separation of the vessel into halves by a joint in the vertical plane. Evacuation is accomplished by either mercury diffusion pumps, backed by rotary mechanical pumps, or liquid Helium Cryo pumping in conjunction with turbomolecular pumps. Both systems are being evaluated. (auth)

10171 (CONF-751125—92) **PDX mechanical and coiled supports.** Knutson, D.; Willard, J.; Bialek, J.; Malick, F.S. (Princeton Univ., N.J. (USA). Plasma Physics Lab.; Westinghouse Research Labs., Pittsburgh, Pa. (USA)). 1975. 3p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The principal function of the Princeton Divertor Experiment (PDX) mechanical structure is to provide support for the toroidal field (TF) and the poloidal field (PF) coil systems. These coil systems are subjected to forces produced by the interaction of their currents with various magnetic fields. The structural components are designed to support the coil systems for gravity loading, operating forces, and forces arising from fault conditions. In addition the mechanical structure supports the vacuum vessel and its internal components. The TF coil support system accounts for most of the structure. The mechanical structure is complicated by the demountable design of the TF coils. The demountable design was adopted to permit easy access for removal or rearrangement of the divertor coils located within the bore of the TF coils. (auth)

10172 (CONF-751125—105) **Conceptual design of a divertor for a tokamak experimental power reactor.** Georgievsky, A.V.; Gralnick, S.L.; Jassby, D.L.; Meade, D.M.; Saksagansky, L.G.; Stephanovsky, A.M.; Tenney, F.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 7p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A design for a Double-Null Poloidal Divertor for a Tokamak EPR is presented which allows remote assembly of the torus and utilizes a standard neutral pumping and heat removal system. (auth)

10173 (MATT—1192) **Maximum neutron wall loadings in beam-driven tokamak reactors.** Jassby, D.L.; Towner, H.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 13p. Dep. NTIS $4.00.

If a beam-driven D—T tokamak reactor is operated at the maximum density allowed both by pressure limitation and by

adequate neutral-beam penetration, the 14-MeV neutron wall loading increases approximately linearly with magnetic field or vertical elongation of the plasma. With elongation = 3, B/sub tmax/ equals 15T, W/sub beam/ = 200 keV, Q approximately 1.0, maximum wall loading is about 5 MW/m². (auth)

10174 (MATT—1193) **Pulsed gas load pumping of hydrogen by vapor deposited titanium films.** Martin, G.D. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 30p. (CONF-751125—135). Dep. NTIS $4.00.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The Princeton Poloidal Divertor Experiment (PDX) plans to use titanium gettering of hydrogen to provide the high pumping speeds required to capture the pulsed gas load which occurs in the region where the diverted plasma is neutralized. Detailed information with respect to hydrogen titanium film interactions under similar conditions was sought so that engineering decisions could be made with greater confidence. Pumping speeds for hydrogen on titanium films were determined by admitting a pulse of gas into the volume enclosed by the substrate and measuring the time constant of the pressure decay. The measurement was made periodically as the film was deposited, and when the maximum sticking coefficient was reached, sublimation was stopped and additional gas pulses admitted to determine the speed vs. hydrogen concentration in the Ti film. The amount of gas per pulse varied from 0.25 to 5 monolayers. Atomic hydrogen produced by thermal dissociation in a continuous measurement gave minimum-values for the sticking coefficient of 0.3 for a room temperature film. A summary of results is shown. Titanium film peeling tests were performed and sublimation sources were test operated. (auth)

10175 (SAND—75-5766) **Study of REB target irradiation, deposition, and implosion.** Chang, J.; Mix, L.P.; Perry, F.C.; Widner, M.M.; Poukey, J.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 32p. (CONF-751108—20). Dep. NTIS $4.00.

From 1. international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

Flat targets, spheres, and hemispheres were irradiated with intense REB (approximately 10^{11} W/cm²) from the Hydra machine to study target loading, ablation, and implosion. A wide variety of experimental techniques were used in these studies including x-ray pinhole photography, laser holography, laser velocimetry, and flash x-radiography. The energy absorption mechanism was found to be consistent with classical electron deposition. Variations in target loading and implosion symmetry have been observed and, in particular symmetry of loading can be altered by changing the cathode geometry and anode-cathode spacing. (auth)

10176 (UCRL—77259) **Leak hunting problems associated with controlled thermonuclear fusion experiments.** Batzer, T.H.; Murphy, J.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Aug 1975. 26p. (CONF-751163—1). Dep. NTIS $4.50.

From 22. national vacuum symposium of the American Vacuum Society; San Diego, California, United States of America "USA" (18 Nov 1975).

The LLL 2xIIB experiment is briefly described. The vacuum system uses mercury diffusion pumps and titanium sublimation. The base pressure of the guard vacuum is about 10^{-5} torr and about 2 x 10^{-7} torr in the high vacuum space using the diffusion pumps only. After titanium sublimation, the high vacuum pressure drops into the 10^{-8} torr range. A procedure for leak testing using a special sniffer probe is described. (MOW)

10177 (ERDA-tr—66, pp 39-42) **Comments on design of "PERF" installation.** Kolbasov, B.N.; Panov, D.A.; Pleshivtsev, N.V.; Popkov, G.N.; Semashko, N.N.; Shatalov, G.E. Oct 1975. Translation of Russian paper.

In Selected USSR papers on plasma physics and controlled thermonuclear fusion.

The development of the PERF neutron generator is discussed. The source properties and its use for investigating thermonuclear reactor materials are briefly described. (MOW)

GENERAL AND MISCELLANEOUS

10178 (ORNL—5046) **Health Physics Division annual progress report for period ending June 30, 1975.** (Oak Ridge National Lab., Tenn. (USA)). Sep 1975. Contract W-7405-eng-26. 323p. Dep. NTIS $10.60.

Separate abstracts were prepared for 25 sections of the progress report. (SFL)

MANAGEMENT

REFER ALSO TO CITATION(S) 9206

10179 (COO—3368-6) **Nuclear Science: a survey of funding, facilities, and manpower.** (National Academy of Sciences - National Research Council, Washington, D.C. (USA)). 1975. 138p. Dep. NTIS $6.00.

In 1973 the Committee on Nuclear Science of the National Research Council initiated a re-examination of aspects (funding, manpower, and facilities) of the organization and operation of nuclear science research in order to evaluate any changes in the preceding four years and implications of such changes. The reports of the three ad hoc panels established for this purpose (funding and level of effort, nuclear facilities, manpower and education) are presented. Although they identify current problems in nuclear science, these reports do not provide simple solutions; rather, they attempt to provide updated information for use as background for continuing decisions. (RWR)

10180 (ERDA—87-2) **Techniques Handbook-Project Management. Milestone planning techniques. ERDA Handbook 0805.3 Part II.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Management Information and Telecommunications). 1974. 33p. Dep. NTIS $5.45.

10181 (ERDA—98) **High energy physicists and graduate students, 1975 census.** (Energy Research and Development Administration, Washington, D.C. (USA)). Nov 1975. 358p. Dep. NTIS $10.60.

This listing of physicists and students associated with the U. S. high energy physics program has been compiled in the Office of the Assistant Director for High Energy Physics of the Division of Physical Research of the U. S. Energy Research and Development Administration. This listing has been obtained by asking the research groups, laboratories, and other agencies involved to update our previous listing. We would like to take this opportunity to thank the many contributors who assisted in submitting information. In addition, we would like to thank the National Science Foundation program office for their assistance in obtaining information on their grantees. This listing is in two parts. The first part is an alphabetical listing and includes only the name, rank, and institution of high-energy physicists and graduate students. The second part of the listing is arranged by institution. Within each institution, the faculty (or permanent staff) and the graduate students are presented in separate alphabetical lists. For each person, the entry indicates his birthdate, the year and institution of his highest degree, his rank and institutional affiliation with starting dates, up to three items selected from a list of research specialties, and his sources of federal support. For the graduate students, there is indicated an estimated date for degree reception. Where appropriate, a person is listed at more than one institution. Except as noted in the listings, the information is intended to indicate the situation as of January 1, 1975. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 9206, 9349, 9409, 9468, 9537, 9557, 9604, 9720, 9942

10182 (AAEC/E—368) **Contour plotting from arbitrarily spaced data points within a region of arbitrary shape.** Davidson, M.R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1975. 15p. Dep. NTIS (US Sales Only) $3.50.

A triangular mesh with data points as vertices is determined. Points on the contours are calculated by linear interpolation along triangle sides. Allowance for general boundary shapes gives the method applications in physics and engineering. 4 figures. (auth)

10183 (BNWL-SA—5614) **Examples of practical computer animation.** Mace, W.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 6p. (CONF-751168—1). Dep. NTIS $3.50.

From Regional meeting of the SMPTE; Seattle, Washington, United States of America "USA" (21 Nov 1975).

A brief description is given of three different examples of computer animation. The first uses a two color process made with two separate exposures on two rolls of photographic film which were subsequently A and B printed. The second was generated using a color television monitor and was done in full color at one time. The final example used three rolls of photographic film, exposed separately and printed later on one roll. (GHT)

10184 (CEA-CONF—3059) **Sequence of test research for complex digital circuits. RECH program.** Blanca, E.; Guirguis, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 28 Apr 1975. 16p. (In French). (CEA-SES-INT-SERF—75-104). INIS.

From Semiconductor international; Wiesbaden, F.R. Germany (4 Mar 1975).

RECH is a program for the generation of sequences of tests for fault detection in circuits built of components such as to form M.S.I. or L.S.I. The chosen alogrithm is based on the global simulation of the components behaviour. A library which contains the fault and good running representations of the components is stocked in the memory of the treating calculator. Using this library, the tests to be applied to the circuit are automatically fetched. The dialogue user-computer, which permit the program to find tests in almost all cases, is facilitated by APL which is the programming language used. (FR)

10185 (CEA-CONF—3060) **Sequence of test production for the failure detection in simple element digital circuits. DETECT program.** Blanca, E.; Nguyen Tran Huy. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). Mar 1975. 4p. (In French). (CEA-SES-INT-SERF—75-40). INIS.

From Semiconductor international; Wiesbaden, F.R. Germany (4 Mar 1975).

Starting a description using elements (gates, flip-flop...) of a binary-digital combinatorial or sequential system, DETECT generates a reducted set of tests whose application allows to detect failures of the system. For each connection to be tested, DETECT establishes: a propagation path of the fault; the corresponding internal state of the circuit. The research ends when the list of connections to be considered is exhausted. Written in PL1, the inputs to the program are: a topologic matrix (numerical description according to a code) or a figurative matrix (names or types of functions...) in this case, elements may be grouped creating macrofunctions. The outputs are: a list of input states or sequences to be applied; the list of corresponding output states; the list of connections that may be faulty, and are equivalent to a fault representation of the system. For sequential circuits, the results depend essentially on the method used for the synthesis of the system. (FR)

10186 (CEA-CONF—3062) **An algorithm of test generation for M.S.I. and L.S.I.** Guirguis, V.; Blanca, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 1975. 18p. INIS.

From International colloquium on the reliability and availability of computer systems; Paris, France (18 Jun 1975).

A new method, is described for the simulation and test generation of electronic digital type circuits. Both combinational and sequential circuits may be treated. The method is developed for attacking M.S.I. and L.S.I. but may be applied to small circuits. The use of a conversational programming language, for such a method is discussed. An example treated by an APL program is given (500 elementary modules, 74 seconds CPU on IBM 360/75, with 9 test circuits completely tested). (FR)

10187 (CERN—75-19) **Instruction timing for the CDC 7600 computer.** Lipps, H. (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Dec 1975. 78p. Dep. NTIS (US Sales Only) $5.00.

This report provides timing information for all instructions of the Control Data 7600 computer, except for instructions of type 01X, to enable the optimization of 7600 programs. The timing rules serve as background information for timing charts which are produced by a program (TIME76) of the CERN Program Library. The rules that coordinate the different sections of the CPU are stated in as much detail as is necessary to time the flow of instructions for a given sequence of code. Instruction fetch, instruction issue, and access to small core memory are treated at length, since details are not available from the computer manuals. Annotated timing charts are given for 24 examples chosen to display the full range of timing considerations. 24 figures (auth)

10188 (CONF-741040—P2, pp 243-254) **Electron memory access.** Kelly, J. (Stanford Research Inst., Menlo Park, CA). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Vol. II.

The concept of the electron-beam-addressed memory (EBAM) is aimed at producing large read/write or read-only memories with fast access times, high data rates, and low cost. Recent work at SRI has demonstrated the feasibility of making tubes with a data capacity in excess of 1 million bits per tube and random access times of better than 3 μs. There are two key elements in this type of system: the storage target and the means by which the electron beam is deflected to repeatedly address a particular location on the target. These elements are discussed in detail. Also given are some details of an experimental memory module delivered to the U. S. Air Force in January 1974.

10189 (COO—2383-0026) **Block envelope solution of finite difference systems.** Sherman, A.H. (Illinois Univ., Urbana (USA)). Nov 1975. Contract AT(11-1)-2383. 21p. (UIUCDCS-R—75-765). Dep. NTIS $3.50.

A description is given of an envelope-oriented block Gaussian elimination method for solving linear systems arising from the use of five-point finite-difference approximations on n x n square grids. The method requires O(n/sup $^3/_2$/) storage locations and O(n/sup $^7/_2$/) arithmetic operations. Asymptotically, this is a significant improvement on the costs of ordinary band and envelope methods; but, for moderate values of n (say, n less than or equal to 50), the band and envelope methods are superior. 2 figures, 2 tables. (auth)

10190 (COO—2482-2(Rev.)) **Direct image reconstruction of anomalies in a plane via physical optics far field inverse scattering.** Bleinstein, N. (Denver Research Inst., Colo. (USA)). 1976. Contract AT(11-1)-2482. 32p. Dep. NTIS $4.00.

It is shown how to process backscattered acoustic data to directly generate the image of an anomaly in a plane, such as an anticline, a synclne or fault. The result is based on a physical optics far field inverse scattering (POFFIS) identity. This identity states that a phase and range normalized scattering amplitude is proportional to a function which is unity in the region of the anomaly and zero outside that region.

10191 (COO—3077-97) **Progress report No. 51, July 1, 1974—June 30, 1975. Technical summary.** (New York Univ., N.Y. (USA). Courant Inst. of Mathematical Sciences). 1 Nov 1975. Contract E(11-1)-3077. 31p. Dep. NTIS $4.50.

Research work in the following areas is briefly reviewed: applied mathematics and mechanics (computational fluid dynamics, controlled thermonuclear research, numerical analysis); computational physics, chemistry, and biology; computer science research (computer netting; programing languages and compilers; operating systems, micro-processor networks, and modular systems); and systems programing, user services, and hardware support. A list of publications is also given. (RWR)

10192 (COO—3077-99) **Numerical solution of Helmholtz's equation by the capacitance matrix method.** Widlund, O.; Proskurowski, W. (New York Univ., N.Y. (USA). Courant Inst. of Mathematical Sciences). Nov 1975. Contract E(11-1)3077. 104p. Dep. NTIS $5.50.

The computer solution of the Helmholtz equation is discussed. Problems can be treated on bounded regions which do not allow for separation of variables. The topics treated in the report are as follows: certain results from classical potential theory, the imbedding of discrete Poisson problems, a capacitance matrix method for the Dirichlet case, a capacitance matrix method for the Neumann case, the Fourier—Toeplitz method and the fast generation of the capacitance matrix, the conjugate gradient method, previous work on capacitance matrix methods, numeral experiments, and outline of a computer program for the numerical solution of the interior Helmholtz equation in two variables with the Dirichlet and Neumann boundary conditions by finite difference methods. 3 figures, 8 tables. (RWR)

10193 (IFA-DT—1-1975) **Structure of block-automorphisms of M x S^1.** Burghelea, D. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 38p. Dep. NTIS (US Sales Only) $4.00.

Let A be one of the geometric categories, Diff, Pl, and Top, where these are, respectively, the category of differentiable manifolds and differentiable maps, the category of p.l manifolds and p.l maps, and the category of topological manifolds and continuous maps. N/sup A/(M) is the nilpotency space, m/sup n/ is any compact connected manifold, and he stands for homotopy equivalent. It has been shown that the homotopy type of N/sup A/(M) is a topological invariant in the sense that, for M/sup n/ belonging to ob Diff, N/sup Diff/(M) he N/sup Pl/(M) he N/sup Top/(M), and for M/sup n/ belonging to ob Pl, N/sup Pl/(M) he N/sup Top/(M). The purpose of this paper is to find a similar result for A(M x S^1) and to show that in stable range N/sup A/(M) is a tangential homotopy invariant. (RWR)

10194 (IS—3800) **Reference manual for the SDS-910 cross-assembler.** Brobst, K.R.; Moon, L.C.; Helland, B.J. (Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA)). Jan 1976. Contract W-7405-eng-82. 50p. Dep. NTIS $4.00.

An IBM-360 cross-assembler for a SDS-910 computer system was broken down into two major programs. The first pro-

gram assembles SDS-910 Assembly Language code, and the second program uses information supplied by the first to produce a reference list of all identifiers used in the source SDS-910 Assembly Language program. Listings, documentation, and sample results are given for the two programs. (auth)

10195 (IS-M—58) **Developing software for a minicomputer laboratory.** Bulger, P.A.; Smith, C.L.; Wright, C.T. (Ames Lab., Iowa (USA)). 1976. Contract W-7405-eng-82. 10p. (CONF-760302—2). Dep. NTIS $3.50.

From ACM conference on programming micro;mini computers; New Orleans, Louisiana, United States of America "USA" (4 Mar 1976).

Minicomputer systems have tremendous potential as laboratory devices in the teaching of computer science. For this potential to be realized, however, appropriate software is needed to support the various laboratory "exercises". This paper describes one approach to the development of such laboratory software. (auth)

10196 (JUL—902-DV) **Concept for the construction of the on-line data processing system in the KFA.** Jordon, H.L.; Abend, K.; Ballensiefen, G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Kommission fuer Datenverarbeitung). Dec 1972. 42p. (In German). Dep. NTIS (US Sales Only) $5.00.

The report of the Data Processing Commission is presented. It was set up for the purpose of developing proposals for the construction and expansion of the total data processing in the Juelich Research Center. It would coordinate the supplying of all data acquisition and processing devices and evaluate their usefulness. It would submit proposals for their financing. The requirements placed on an on-line data processing system for the Research Center were formulated, and the current status of data processing at the Center was evaluated with recommendations for its improvement and expansion. Personnel and financial proposals were included. 7 figures, 2 tables (JSR)

10197 (LA—6187-MS) **Jacobi algorithms for integers.** Johnson, R.W.; Waterman, M.S. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-ENG-26. 15p. Dep. NTIS $4.50.

Jacobi's algorithm, usually given for pairs of reals, has an integer analog for triples of integers. This algorithm and an alternative algorithm are presented along with the connection with computing greatest common divisors. A technique of D. H. Lehmer's is generalized for efficient computation of Jacobi algorithms. Listings of FORTRAN programs for these procedures are given. (auth)

10198 (LBL—4604) **Generalized conjugate gradient method for the numerical solution of elliptic partial differential equations.** Concus, P.; Golub, G.H.; O'Leary, D.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-ENG-48. 28p. (CONF-750987—2; STAN-CS—75-533). Dep. NTIS $4.00.

From Symposium on sparse matrix computations; Argonne, Illinois, USA (9 Sep 1975).

A generalized conjugate gradient method is considered for solving sparse, symmetric, positive-definite systems of linear equations, principally those arising from the discretization of boundary value problems for elliptic partial differential equations. The method is based on splitting off from the original coefficient matrix a symmetric, positive-definite one that corresponds to a more easily solvable system of equations, and then accelerating the associated iteration using conjugate gradients. Optimality and convergence properties are presented, and the relation to other methods is discussed. Several splittings for which the method seems particularly effective are also discussed; and for some, numerical examples are given. 1 figure, 2 tables. (auth)

10199 (LBL—4648) **Improved shift strategy for the QR-algorithm for real Hessenberg matrices.** Karasalo, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1976. Contract W-7405-Eng-48. 19p. Dep. NTIS $3.50.

Some experimental results on the behavior of the QR algorithm for real Hessenberg matrices are presented, with shifts calculated from a p x p lower right-hand submatrix where p may be >2. Convenient implementation of one such shifting strategy in a programing language is discussed; recursive procedure calls are permitted by modifying slightly the ALGOL procedure HQR [Martin, Peters, and Wilkinson, Numer. Math. 14, 219-31 (1970)]. In the comparison the modified procedure gives in general a 15 to 20% reduction of the total operations count for transforming the Hessenberg matrix to block triangular form (with diagonal blocks of order less than or equal to2) and updating the product of the orthogonal transformation matrices. 7 tables. (auth)

10200 (ORO—3443-56) **Solution of interface problems by homogenization. III.** Babuska, I. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Sep 1975. Contract AT(40-1)-3443. 31p. (TN-BN—827). Dep. NTIS $4.00.

Homogenization is generalized to nonlinear differential equations. With previous results as a basis, a simplified proof is presented which holds for the nonlinear case. 2 figures. (RWR)

10201 (ORO—3443-57) **Mathematical problems of computational decisions in the finite element method. Technical report TR-426.** Babuska, I.; Rheinboldt, W. (Maryland Univ., College Park (USA)). Dec 1975. Contract AT(40-1)-3443. 46p. (NSF-OCA-GJ—35568X-426). Dep. NTIS $4.00.

Present programs for finite-element analysis require the user to make numerous, critical a priori decisions. They often represent difficult mathematical problems and may influence strongly the accuracy and reliability of the results, the cost of the computation, and other related factors. This paper discusses some of these decisions and their mathematical aspects in the case of several typical examples. More specifically, the questions addressed here concern the effect of different mathematical formulations of the basic problem upon the results, the influence of the desired accuracy on the efficiency of the process, the selection and comparison of different types of elements, and for nonlinear problems the choice of efficient methods for solving the resulting finite-dimensional equations. In all cases a consistent use of self-adaptive techniques is strongly indicated. (auth)

10202 (SAND—75-6076) **Binary computer generated holograms as spatial filters.** Hansche, B.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 9p. (CONF-760206—1). Dep. NTIS $3.50.

From The topical meeting on image processing; Pacific Grove, California, United States of America "USA" (24 Feb 1976).

The Generalized Binary Computer Generated Hologram is an algorithm which makes efficient use of graphics devices, which can plot only a limited number of points, to generate holographic spatial filters. The nature of the set of complex amplitudes one can code with this algorithm was studied. The main topic is amplitude quantization noise. It is shown that, since the quantization steps vary in size, the optimum signal normalization is not necessarily that which uses all the quantization steps. The amplitude quantization noise is analyzed in several types of real-values holograms to demonstrate this behavior. The results of a measurement of errors in dot size and dot position on a storage tube terminal are given and related to the analysis of amplitude quantization noise. (GHT)

10203 (SES-PUB-SEG—74-126) **Extension of PDP8 BASIC for use of CAMAC modules.** Nguyen, K.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 12 Jun 1974. 38p. (In French). Dep. NTIS (US Sales Only) $5.00.

The programing language "BASIC" is one of the simplest computer languages to learn. It is used in many automatic measurement systems. In the application described, this language is used to transfer data between a mini-computer and the "CAMAC" system. The functions which direct the data transfer (read, write, etc.) are written in assembly language. An overlay interfaces these routines to OS8 BASIC. (auth)

10204 (UCCND-CSD-INF—59) **ADTABLE: an ORCHIS program for tabular reports of information in ADSEP data sets.** Singletary, V.A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 76p. Dep. NTIS $6.00.

This report is a user quide for the ADTABLE computer program. It describes how the program can be used, the preprocessing required on the input file, how to control the computer resources, and how to specify program control. The program is an integral part of the Oak Ridge Computerized Hierarchical Information System (ORCHIS). It is a multipurpose report generator that can produce tabular displays of information from ADSEP-produced files stored in textual or computational form. 5 tables. (auth)

10205 (UCID—16961) **Full duplex CRT and teletypewriter driver.** McGoldrick, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Dec 1975. Contract W-7405-eng-48. 56p. Dep. NTIS $5.45.

The full duplex CRT and TTY driver runs under Interdata's Real Time Operating System. The following enhancements are obtained with the full duplex driver over current CRT and TTY drivers. The driver is reentrant and controls many CRTs and TTYs of differing types, because device-dependent information is kept in the device's control block. Input and output is separate (full duplex requires a PASLA interface). The system console may be assigned to any device controlled by this driver. The driver standardizes control characters by handling them internally (such as

delete character, etc.). The driver allows a calling task to write a prompt character and read in one indivisible step. The driver allows a carriage return-linefeed after a write to be suppressed. The driver handles the writing of nulls before each line to devices requiring them. (auth)

10206 (UCID—17003) **Neworld: a world dynamics code for assessing the impact of space colonization.** Vajk, J.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jan 1976. Contract W-7405-eng-48. 43p. Dep. NTIS $4.00.

This report is a companion to UCRL-77584, "The Impact of Space Colonization on World Dynamics", by J. Peter Vajk, November 14, 1975. To permit other modelers to scrutinize the work reported in that paper, this report contains three sections detailing the model used. Section I contains a list of variables used, their definitions, and the dimensions or units of each variable. Section II contains the variable declarations and storage allocations for the program, while Section III lists the entire program. The programming language used is LLLTRAN, the Livermore dialect of FORTRAN IV. This dialect contains a number of features not found in ANSI FORTRAN; these are documented in Reference 1. Calls to subroutines which do not appear in the listing here are to library subroutines (ORDERLIB) which are documented in Reference 2. (auth)

10207 (UCID—30048(Rev.2)) **User's guide to the Octopus computer network (the SHOC manual).** Schneider, C.; Thompson, D.; Whitten, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jun 1975. Contract W-7405-Eng-48. 83p. Dep. NTIS $5.45.

This guide explains how to enter, run, and debug programs on the Octopus network. It briefly describes the network's operation, and directs the reader to other documents for further information. It stresses those service programs that will be most useful in the long run; "quick" methods that have little flexibility are not discussed. The Octopus timesharing network gives the user access to four CDC 7600 computers and a broad array of peripheral equipment, from any of 800 remote terminals. Octopus will soon include the Laboratory's STAR-100 computers. 9 figures, 5 tables. (auth)

10208 (UCID—30100(Rev.1)) **TRIX: an interactive, interpretive language for manipulating strings of characters.** Moll, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Dec 1975. Contract W-7405-Eng-48. 52p. Dep. NTIS $4.50.

TRIX is a language for manipulating strings of characters. It consists of functions and a syntax for assembling those functions into named procedures called macros. A program written for the TRIX interpreter is called a dialect. The TRIX user writes a dialect (program) by writing a series of macros as a disk file, and then reads in (interprets) the dialect and executes the macros to carry out operations on a text file. Dialects run under TRIX are used for text editing, where text can be source code (e.g., a Fortran disk file) or English-language text. This report describes in detail the basic TRIX functions, the TRIX syntax, and brief examples of macros, showing applications to text-editing procedures. TRIX is an executable controllee (written in assembly language) available on the CDC 6600 and 7600 computers of the Livermore time-sharing system. 3 figures. (auth)

10209 (UCID—30118) **TMDS manual.** Fletcher, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Feb 1976. Contract W-7405-eng-48. 42p. Dep. NTIS $4.00.

The Television Monitor Display System (TMDS) is an Octopus subnetwork that supports up to 512 television monitor devices. These devices enable the user to display both text and graphic pictures. This manual explains how the user interacts with TMDS, describes the format of display information, and also covers various aspects of TMDS operation of interest to the system programmer. (auth)

10210 (UCID—30126) **CONCORD: a word index generator for arbitrary text strings.** Ramus, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Nov 1975. 17p. Dep. NTIS $3.50.

The CONCORD computer program creates a concordance for arbitrary text strings. These alphabetically ordered word indexes can be used as lookup tables for bibliographic, administrative, or scientific information and data. The program selects essential terms from the input text according to an algorithm using user-specified ACCEPT or REJECT lists. The program contains options for printing the index terms on either the left or right side of the page to facilitate visual lookup on microfiche or on single-page computer-printed output. Large files containing 50,000 references can be produced in about 10 minutes of CDC 7600 computer time. (5 figures) (auth)

10211 (UCID—30127(Pt.1)) **PLOTPK: an interactive program that creates graphs and edits pictures. Part 1. User's guide.** Keller, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Jan 1976. Contract W-7405-eng-48. 29p. Dep. NTIS $4.00.

PLOTPK is a quick and easy way of plotting data, and a flexible means for analyzing it. PLOTPK contains the tools one needs to create two- and three-dimensional graphs and send them to a TMDS screen, RJET printer, or FR80-generated film. A scientist or engineer can use PLOTPK to scan a volume of data, looking for correlations between parameters and visually validating the data. Although PLOTPK does not validate raw data, it does present it in different forms so that the user can evaluate it at a glance. In many cases he is better able to validate the data than is any mathematical subroutine. Because PLOTPK is designed to make it easy for the user to interact with the data, it is not appropriate for production jobs involving hundreds of pictures a day. It is, however, an efficient tool for production in which just a few pictures per day are generated, for in such a case it is quicker to use the PLOTPK program than to write a new one. Part 2 of this report, the "reference document," discusses DO-loops (to make movies), macros for shortcuts, and sorting to help analyze data. (auth)

10212 (UCID—30127(Pt.2)) **PLOTPK: an interactive program that creates graphs and edits pictures. Part 2: reference manual.** Keller, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Dec 1975. Contract W-7405-Eng-48. 73p. Dep. NTIS $4.50.

This reference manual describes PLOTPK in detail. Part 1 is the user's guide; if you haven't the time or the inclination to wade through Part 2, read Part 1 of this report. It describes (with pictures and examples) the quick and easy ways of generating plots. PLOTPK is a convenient way of plotting data and a flexible means for analyzing it. PLOTPK contains the tools one needs to create graphs. Once such a picture is created, the user can select the medium to send it out on: TMDS screen, RJET printer, or FR80-generated film. A scientist or engineer can use PLOTPK to scan a volume of data from his research to look for correlations between parameters or to validate the data visually. Although PLOTPK does not validate raw data, it does present the data in various forms so that the user can evaluate it at a glance--in many cases, he is better able to validate the data than is any mathematical subroutine. PLOTPK is designed to make it easy for the user to interact with the data; and hence is not designed for production jobs involving hundreds of pictures per day. It is, however, an efficient tool for production in which just a few pictures per day are generated, for it is quicker in such a case to use the PLOPK program than to write a new one. 1 table (auth)

10213 (UCRL—51970) **Display octal debugging technique (DODT-80) for the MCS 80 microcomputer.** Spann, J.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1976. Contract W-7405-eng-48. 21p. Dep. NTIS $3.50.

DODT-80 is an octal debugging routine for the Lawrence Livermore Laboratory (LLL) MCS-80 microcomputer system the CPU of which is an Intel 8080 microprocessor. This routine allows the user to examine and modify all of the memory that is available to the microcomputer and to transfer program control to the created program. DODT-80 has the capability of operating from simple keyboard commands and displaying both inputs and results on a CRT terminal. (auth)

10214 (UCRL—77110) **Computer algorithm for transposing large matrices using limited primary storage.** Twogood, R.E.; Ekstrom, M.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov 1975. 6p. (CONF-760105—2). Dep. NTIS $4.50.

From 9. Hawaii international conference on system sciences; Honolulu, Hawaii, United States of America ªUSAª (6 Jan 1976).

Eklundh's fast matrix transposition algorithm for transposing a 2/sup n/ x 2/sup n/ matrix is extended here to the general case where 2/sup j/(j greater or equal to 1) of its rows will fit into primary storage. The performance characteristics of the extension are described and subsequently compared with those of Eklundh. 1 figure. (auth)

10215 (UCRL—77453) **Baby brother system.** Albert, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-Eng-48. 16p. (CONF-760302—1). Dep. NTIS $4.50.

From ACM conference on programming micro;mini computers; New Orleans, Louisiana, United States of America ªUSAª (4 Mar 1976).

A computer network performance monitoring system is described. Its principal components are a PDP-11/10 processor

with 8K of memory, a 16-channel teletype multiplexor, support teletypes, and teletype lines to network concentrators. The primary functions are automatic hardware checking, statistics collection, and automatic supervision of external programs on other host computers. A multiprocessing operating system dedicated to supporting this mission and the processes that accomplish these tasks are described. 3 figures (auth)

10216 (UCRL—77555) **Analysis of operating system security.** Chin, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Dec 1975. Contract W-7405-Eng-48. 26p. (CONF-7506113—1). Dep. NTIS $4.00.

From 1976 national computer conference; New York, New York, United States of America "USA" (7 Jun 1975).

Much research has been directed at designing a "secure" operating system. The majority of present-day systems were not designed with security requirements as significant factors. As a result, these operating systems have been and continue to be compromised by system-knowledgeable programers. The security problems in these systems can be dealt with only after they have been identified. The RISOS (Research In Secured Operating Systems) Group at the Lawrence Livermore Laboratory has developed a methodology to locate problem areas and to identify ways of compromising systems. 3 figures, 2 tables. (auth)

10217 (UCRL—77624) **Static tools for the analysis of operating system security.** Huskamp, J.C.; Frickel, W.G.; Webb, D.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Dec 1975. 23p. (CONF-7506113—2). Dep. NTIS $3.50.

From 1976 national computer conference; New York, New York, United States of America "USA" (7 Jun 1975).

Analytic tools are used to automate the system security analysis function. With these tools, each step of the analysis methodology can be executed faster and more thoroughly than by manual methods alone. One useful analytic tool is the static informational tool that operates on a data base constructed from the system listings. The implementation of a static informational tool for system security analysis is presented and design considerations for future tools of this type are given. 2 figures (auth)

10218 (UCRL—77766) **Administrative minicomputer complex as an extension to the central computing facility.** Seibel, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jan 1976. 29p. (CONF-760308—1). Dep. NTIS $4.00.

From Minicomputers-the applications explosion conference; San Francisco, California, United States of America "USA" (22 Mar 1976).

Lawrence Livermore Laboratory currently operates a large central computing facility essentially configured with 4 CDC 7600 computers and 2 CDC STAR 100 computers, a trillion bit storage device, and several communication networks including one composed of nearly 1000 terminals for timesharing. It has been found, however, that many applications, including some Administrative type functions, are better served by small minicomputer systems rather than the large computing complex. This report presents a survey of those minicomputer applications which are primarily oriented toward the business functions of the Laboratory. (auth)

10219 **Part of the Octopus system (Engineering Materials) (15 Jan 1974).** (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE—2404).

28 drawings.

10220 (UCRL-Trans—10985) **Approximate solution of systems of linear equations.** Kaczmarz, S. Translated from *Bull. Int. Acad. Pol. Sci. Lett., Cl. Sci. Math. Nat., Ser. A;* **3**: No. 3, 355-357(1937). 5p. Dep. NTIS $3.50.

The solution of systems of linear equations is considered. An iterative technique is presented for the general solution of such systems. (RWR)

10221 **Convergence estimates for Galerkin methods for variable coefficient initial value problems.** Thomee, V. (Chalmers Univ. of Tech., Goteborg); Wendroff, B. *SIAM (Soc. Ind. Appl. Math.) J. Numer. Anal.;* **11**: No. 5, 1059-1068(Oct 1974).

The use of Galerkin's method for the approximate solution of the initial value problem for certain simple equations delta u/delta t = Pu, where P is a differential operator of order m with respect to x, is analyzed when the approximate solution is sought in the space of smooth splines of order μ based on a uniform mesh with mesh-width h. It is proved that at the mesh-points the error can be made to be O(h/sup v/), where v = 2μ - m for m even, v = 2μ - m + 1 for m odd. (auth)

10222 **Vychislitel'nye Sistemy: sbornik statei, Vyp. 42. (Computer Systems: collection of articles, Vol. 42).** Evreinov, E.V.; Kosarev, Yu.G. (eds.). New Delhi, India; United States of America (USA); Amerind Publishing Co. Pvt. Ltd. (1975). 148p. (TT—72-52018).

Translated by M.K. Sobti.

This collection contains articles dealing with the structure of Universal Computer Systems (UCS) with program-altered links, mathematical provision, creation of effective translators, working regimes of UCS-type program for solving taxonomic problems on the system Minsk-222, and the study of effective pickups of random numbers for statistical modeling. The information in this volume is of interest to design engineers and specialists working in the field of application of computer systems and methods of data processing. (RWR)

10223 **Statistics of derived intensities.** McCandlish, L.E. (Univ. of Washington, Seattle); Stout, G.H.; Andrews, L.C. *Acta Crystallogr., Sect. A;* **A31**: 245-249(Mar 1975).

The variance of diffractometer-collected diffraction intensities is discussed in terms of instrumental instability and uncertainties in the parameter used to bring the intensities to a common scale. It is shown that the inconsistent and/or divergent behavior of the reflections used as standards contributes in a major way to the uncertainty in the scaling parameter and can often account for the largest portion of the variance in excess of the Poisson contribution for reflections with large intensities. (auth)

10224 **Damping of a simple pendulum.** Crawford, F.S. (Univ. of California, Berkeley). *Am. J. Phys.;* **43**: No. 3, 276-277(Mar 1975).

An approximate solution of the pendulum equation is found. The damping force is assumed to be proportional to v/sup p/, where p is an unknown power. (BJG)

10225 **Continued fraction expansion of algebraic numbers.** Richtmyer, R.D. (Los Alamos Scientific Lab., NM). *Adv. Math.;* **16**: No. 3, 362-367(Jun 1975).

Every irrational x in [0,1] determines uniquely an infinite sequence of positive integers by means of its continued fraction expansion. Richtmyer in 1951 conjectured that algebraic irrationals may have a paucity of large partial denominators. The conjecture was studied in numerical tests. The numerical work yielded a very strange result for one value of x. The present paper reports further tests for this value. It was found that the previous anomalous value was accidental, and resulted from having stopped the expansion at 725 terms; other stopping points gave quite reasonable values. 4 tables. (RWR)

10226 **Almost periodic behavior of nonlinear waves.** Lax, P.D. (Courant Inst. of Mathematical Sciences, New York). *Adv. Math.;* **16**: No. 3, 368-379(Jun 1975).

The motion of linearly arranged particles driven by nonlinear forces between nearest neighbors has been studied. Recent theoretical results concerning three nonlinear systems are reported here. Each of the systems discussed has an unusually large number of integrals, i.e., functionals conserved during motion; this fact might explain why some numerically computed trajectories of these systems seem to be confined to such an unexpectedly small portion of phase space. However, an additional mechanism must also be at work. The first of the systems discussed is Hamiltonian and completely integrable; accumulating evidence indicates that the second is, also. The Toda lattice, the Korteweg—de Vries equation, and the sine-Gordon equation are considered. (RWR)

10227 **Analysis of some Galerkin schemes for the solution of nonlinear time-dependent problems.** Dendy, J.E. Jr. (Los Alamos Scientific Lab., NM). *SIAM (Soc. Ind. Appl. Math.) J. Numer. Anal.;* **12**: No. 4, 541-565(Sep 1975).

A priori error estimates are derived for several Galerkin procedures. For a nonlinear parabolic initial-boundary value problem, optimal rate L^2-error estimates are derived for the forward and central difference. Laplace modified Galerkin methods and the forward and central difference Laplace modified alternating direction Galerkin methods. For a nonlinear second-order hyperbolic initial-boundary value problem, optimal rate L^2-error estimates are derived for the Laplace modified Galerkin method and the Laplace modified alternating direction Galerkin method. 1 table. (auth)

10228 **Combination shift QZ algorithm.** Ward, R.C. (Union Carbide Corp., Oak Ridge, TN). *SIAM (Soc. Ind. Appl. Math.) J. Numer. Anal.;* **12**: No. 6, 835-853(Dec 1975).

An extension of the QZ algorithm, called the combination shift QZ algorithm, is presented for solving the generalized matrix eigenvalue problem Ax = lambda Bx with real square matrices A and B. Features and properties of the various QR-type algorithms which were not practical or possible to implement in the QZ algorithm are generalized and implemented in this new algorithm. The emergence of infinite eigenvalues under exact arithmetic is

discussed in detail. Results of numerous test cases are presented to give practical application tests and comparisons for the algorithm. 1 figure, 2 tables. (auth)

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 8758, 8759, 8762

10229 (PTB-ATWD—6) **Simplified application of electronic data processing in a natural science and technology special library in combination with an improved literature description.** Bretnuetz, E. (Physikalisch-Technische Bundesanstalt, Braunschweig (F.R. Germany)). Oct 1975. 50p. (In German). Dep. NTIS (US Sales Only) $4.00.

A pilot project in a special library for natural science and technology to record bibliographic data on several kinds of literature within a simplified scheme and to process them in a computer by simple programs is described. The printout consists of several lists arranged according to several aspects. At the same time a relevant thesaurus is tested as to its suitability for an improved description of the literature. The results show that the literature handled is identified sufficiently within this simplified scheme. After supplementation by some special terms, the thesaurus can be used for a deeper analysis of the literature. (auth)

10230 (TID—4584) **ERDA energy information data base. Subject categories.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jan 1976. 51p. TIC.

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into ERDA's computerized bibliographic information system. These numbers are used in the preparation of printed documents, such as bibliographies and abstracting journals, and as searching aids in the on-line system, RECON. This document was prepared for use by those individuals responsible for the assignment of category numbers to documents being entered into the TIC system; those individuals and organizations processing magnetic tape copies of the files; and others who, having no access to RECON, have need for printed copy. (RWR)

LAW

REFER ALSO TO CITATION(S) 9388

10231 (COM—75-10319) **Laws relating to environmental control. Part 2. Preliminary draft.** (Mississippi-Alabama Sea Grant Consortium, Ocean Springs, Miss. (USA)). 1973. 141p. (MASGP—74-030). NTIS $5.75.

Part 2 of the compilation continues with health and safety specifications and requirements directed toward private business and industry. Radiation control, building code maintenance, inspection of fire hazards, and compilation of health data are touched upon. Other sections deal with land-use regulation and pollution control. Under land-use, regulations deal with eminent domain, state and local zoning regulations, and airport location. Administrative agencies designated as watchdogs of pollution control within the state of Mississippi are specified along with their duties, responsibilities, powers, and composition. Limitations on fuel burning, open burning, incineration, and contaminant emissions are specified along with emergency control measures. Permit regulations for new and existing facilities discharging air contaminants are given. Extensive legal citations are presented. (GRA)

CIVILIAN DEFENSE

10232 (ORNL—5046, pp 1-13) **Strategic defense.** Cristy, G.A.; Haaland, C.M.; Kearny, C.H.; Thurmer, R.N. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Topics discussed include national survival after a nuclear attack, Soviet civil defense studies, best shelter for critical industry workers, and expedient life-support equipment for shelters. (TFD)

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In the corporate index, technical report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

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SUBJECT DESCRIPTOR;QUALIFIER
Title (supplementary information), citation number (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

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5595	1:9262	Dep. NTIS, $3.50
5614	1:10183	Dep. NTIS, $3.50
5622	1:8785	Dep. NTIS, $3.50
BNWL-tr-		
161	1:8579	Dep. NTIS, $3.00
162	1:9085	Dep. NTIS, $3.50
C-		
405	1:8724	*See* AD/A-008044
CAC-		
137P	1:8836	Center for Advanced Computation, University of Illinois at Urbana-Champaign, Urbana, IL 61801
CAC/TM-		
48	1:8872	NTIS
49	1:8776	NTIS
60	1:8786	NTIS
CALT-		
822-77	1:10019	Dep. NTIS, $3.50
822-79	1:9040	Dep. NTIS, $3.50
CAPE-		
524(Rev.)	1:9354	EM
2404	1:10219	EM
2412	1:9355	EM
2413	1:9307	EM
2414	1:9308	EM
CEA-CONF-		
3053	1:9263	INIS
3058	1:9274	INIS
3059	1:10184	INIS
3060	1:10185	INIS
3062	1:10186	INIS
3074	1:9146	INIS
3079	1:9343	INIS
3092	1:9041	INIS
3093	1:9065	INIS
3095	1:8968	INIS
CEA-N-		
1814	1:9147	Dep. NTIS (US Sales Only), $4.00
CEA-R-		
4681	1:9371	INIS
4713	1:9344	Dep. NTIS (US Sales Only), $6.00
CEA-SES-INT-SERF-		
75-40	1:10185	*See* CEA-CONF-3060
75-104	1:10184	*See* CEA-CONF-3059
CEA-SES-INT-SGM-		
75-84	1:9274	*See* CEA-CONF-3058
CENC-		
1238(Vol.2)	1:8546	Dep. NTIS, $10.60
CERN-		
75-19	1:10187	Dep. NTIS (US Sales Only), $5.00
CNLM-		
3087	1:8915	Dep. NTIS, $3.50
3871	1:9023	Dep. NTIS, $7.50
6139	1:9081	Dep. NTIS, $3.50
COM-		
75-10319	1:10231	NTIS, $5.75
75-10342	1:9302	NTIS, $3.75
75-10359	1:8894	NTIS, $7.00
75-11070	1:8843	NTIS
CONF-690130-	1:8619	*See* AEC-tr-7295
CONF-7309108-2	1:9399	Dep. NTIS, $4.00
CONF-7309141-	1:9150	*See* JUL-Conf-13
CONF-740137-	1:10048	Bedford Park, Australia; Flinders University of South Australia (1974).
CONF-740315-	1:9092	New York; Plenum Press (1974). $45.00
CONF-740341-P2	1:8494	Westinghouse Electric Corp., Pittsburgh, PA, $5.00
CONF-740651-7	1:9013	
CONF-740829-	1:8693	New York; American Society of Civil Engineers (1974). $10.00
CONF-740903-	1:8565	Oxford; Pergamon Press Ltd. (1975). $30.00
CONF-7410146-2	1:8477	
CONF-7410147-	1:8146	Arlington, VA; American Gas Association (1974). $40.00
CONF-741105-P3	1:10117	*See* STI/PUB-381(Vol.3)
CONF-750110-P2	1:10156	New York; Plenum Press (1975). $35.00
CONF-750112-4	1:9184	*See* UCRL-77709
CONF-750248-1	1:9057	*See* UCRL-77466
CONF-750323-	1:9906	*See* BNL-NCS-50451
CONF-750335-51	1:9610	Dep. NTIS, $4.00
53	1:9608	Dep. NTIS, $4.00
CONF-750356-	1:10111	Innsbruck Univ., Austria
CONF-750411-84	1:8577	*See* ORNL-tr-4004
CONF-750447-	1:9922	*See* ORO-4856-26
CONF-750497-1	1:8971	*See* KFKI-75-61
CONF-750515-	1:8603	Dep. NTIS, $10.00
CONF-750530-3	1:9412	Dep. NTIS, $3.50
CONF-750607-39	1:9015	*See* HEDL-SA-765
CONF-750615-	1:8439	*See* NSF-RA-N-75-050
CONF-750629-7	1:9426	*See* BNL-20753
CONF-750681-1	1:9376	Dep. NTIS, $4.00
CONF-7506102-	1:8168	Chicago; Institute of Gas Technology (1975). $50.00
CONF-7506104-3	1:10036	*See* LBL-4179
CONF-7506113-1	1:10216	*See* UCRL-77555
2	1:10217	*See* UCRL-77624
CONF-750727-1	1:8141	*See* UCID-16845
CONF-750752-1	1:8296	*See* ERDA-tr-90
CONF-750755-	1:8222	National Science Foundation, Washington, DC
CONF-750815-2	1:9987	*See* LA-tr-75-33
CONF-750859-3	1:9102	*See* UCRL-76742

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CONF-750867-		
	1:8478	Dep. NTIS, $10.60
CONF-750868-		
	1:8822	Pittsburgh; University of Pittsburgh (1975). $50.00
CONF-750879-		
	1:8384	Dep. NTIS, $6.75
CONF-750949-		
2	1:9086	*See* SAND-75-5875
10	1:9097	*See* SAND-75-5604
CONF-750950-		
2	1:10020	*See* BNL-tr-619
CONF-750967-		
21	1:8328	*See* MLM-2262
CONF-750975-		
12	1:9571	*See* LBL-3858
CONF-750982-		
2	1:8973	*See* LBL-4563
CONF-750985-		
6	1:9498	*See* UCLA-12-1016
CONF-750986-		
1	1:10030	*See* BNWL-SA-5582
CONF-750987-		
2	1:10198	*See* LBL-4604
CONF-750989-		
3	1:9014	Dep. NTIS, $3.50
CONF-750999-		
1	1:8947	*See* COO-1676-38
CONF-7509103-		
1	1:9427	Dep. NTIS, $4.00
CONF-7509105-		
1	1:8910	Dep. NTIS, $3.50
CONF-7509111-		
1	1:9443	*See* BNL-20807
CONF-751028-		
P1	1:8549	*See* CRBRP-PMC-75-04
CONF-751048-		
4	1:9295	*See* LBL-4210
CONF-751055-		
1	1:8334	*See* SAND-75-6068
CONF-751063-		
2	1:9993	*See* ORNL-TM-5176
2	1:10130	*See* CONF-751125-101
CONF-751070-		
1	1:9428	Dep. NTIS, $4.50
CONF-751071-		
1	1:8616	Dep. NTIS, $4.50
CONF-751080-		
	1:8793	Dep. NTIS, $4.50
CONF-751086-		
1	1:8409	*See* UCRL-77544
2	1:8408	*See* LA-UR-75-2335
3	1:8402	*See* LBL-4422
CONF-751101-		
26	1:8312	Dep. NTIS, $4.00
47	1:8547	Dep. NTIS, $5.00
54	1:8602	Dep. NTIS, $4.50
CONF-751107-		
15	1:8756	*See* BNL-20730
CONF-751108-		
15	1:9239	*See* SAND-75-5798
18	1:9981	*See* UCRL-77202
20	1:10175	*See* SAND-75-5766
CONF-751109-		
10	1:9278	*See* UCRL-77271
CONF-751113-		
10	1:9262	*See* BNWL-SA-5595
CONF-751116-		
11	1:9306	*See* UCRL-76894
20	1:9469	*See* LBL-3872
21	1:8917	*See* LBL-4273
23	1:9330	*See* BNL-20718
24	1:9301	*See* BNL-20720
CONF-751125-		
90	1:10170	Dep. NTIS, $3.50
91	1:10153	Dep. NTIS, $3.50
92	1:10171	Dep. NTIS, $3.50
99	1:10128	Dep. NTIS, $3.50
100	1:10129	Dep. NTIS, $3.50
101	1:10130	Dep. NTIS, $3.50
102	1:10131	Dep. NTIS, $3.50
103	1:10081	Dep. NTIS, $4.00
104	1:10132	Dep. NTIS, $3.50
105	1:10172	Dep. NTIS, $3.50
117	1:10141	Dep. NTIS, $3.50
118	1:10072	Dep. NTIS, $4.00
119	1:10100	*See* MATT-1199
120	1:10073	Dep. NTIS, $3.50
121	1:10136	*See* GA-A-13687
122	1:10133	Dep. NTIS, $3.50
125	1:10134	Dep. NTIS, $3.50
128	1:10142	Dep. NTIS, $3.50
129	1:10050	Dep. NTIS, $3.50
130	1:10051	Dep. NTIS, $3.50
131	1:10143	Dep. NTIS, $3.50
132	1:10127	*See* BNL-20752
133	1:10126	*See* BNL-20726
134	1:10125	*See* BNL-20717
135	1:10174	*See* MATT-1193
136	1:10145	Dep. NTIS, $3.50
137	1:10152	*See* BNL-20716
CONF-751130-		
14	1:10157	*See* UCRL-77139
18	1:10052	*See* COO-2218-60P
CONF-751137-		
1	1:8633	Dep. NTIS, $4.50
CONF-751141-		
2	1:8702	*See* LA-UR-75-2085
3	1:8703	*See* LA-UR-75-2212
CONF-751149-		
1	1:8634	Dep. NTIS, $4.50
2	1:8635	Dep. NTIS, $4.50
CONF-751150-		
4	1:9413	*See* IS-M-57
CONF-751158-		
1	1:9445	*See* LA-UR-76-459
CONF-751161-		
1	1:9350	*See* LA-UR-75-2312
CONF-751163-		
1	1:10176	*See* UCRL-77259
CONF-751168-		
1	1:10183	*See* BNWL-SA-5614
CONF-751209-		
1	1:8974	*See* SAND-75-5779
6	1:8969	Dep. NTIS, $4.50
17	1:9039	*See* BNL-20600
CONF-751212-		
1	1:10026	*See* IS-M-51
CONF-751222-		
1	1:9444	Dep. NTIS, $3.50
CONF-751224-		
1	1:8415	*See* UCRL-77637
CONF-760102-		
3	1:8896	*See* SAND-75-8697
4	1:8361	*See* SAND-75-8695
CONF-760104-		
3	1:9237	*See* SAND-76-5039
CONF-760105-		
2	1:10214	*See* UCRL-77110
CONF-760106-		
1	1:9510	Dep. NTIS, $4.50
CONF-760109-		
1	1:8482	*See* LA-UR-75-2313
2	1:9417	*See* Y-JA-113
CONF-760112-		
1	1:8871	Dep. NTIS, $3.50
2	1:8755	*See* UCRL-77440
3	1:8741	Dep. NTIS, $3.50
CONF-760120-		
1	1:9190	*See* UCRL-77659
CONF-760202-		
6	1:8690	Dep. NTIS, $4.50
24	1:9552	*See* BNL-20767
25	1:9316	*See* BNL-20762
CONF-760203-		
2	1:9114	*See* SAND-75-5848
CONF-760206-		
1	1:10202	*See* SAND-75-6076
CONF-760208-		
1	1:8228	*See* LA-UR-76-86
CONF-760215-		
1	1:8483	*See* SAND-75-6167
CONF-760217-		
1	1:9489	*See* LA-UR-76-228
CONF-760219-		
1	1:8920	*See* UCRL-77850
2	1:9027	*See* UCRL-77844
CONF-760221-		
1	1:9430	*See* LBL-4417

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CONF-760302-		
1	1:10215	*See* UCRL-77453
2	1:10195	*See* IS-M-58
CONF-760304-		
1	1:8352	*See* LA-UR-75-2375
4	1:8353	*See* LA-UR-76-72
5	1:8359	*See* BNL-20902
6	1:8357	*See* BNL-20791
8	1:8358	*See* BNL-20876
CONF-760308-		
1	1:10218	*See* UCRL-77766
CONF-760311-		
4	1:9372	Dep. NTIS, $3.50
CONF-760312-		
1	1:8742	Dep. NTIS, $3.50
CONF-760313-		
1	1:9194	*See* LA-UR-75-2242
2	1:9195	*See* LA-UR-75-2308
CONF-760315-		
3	1:9446	*See* LA-UR-76-525
CONF-760401-		
2	1:9101	Dep. NTIS, $3.50
3	1:8389	*See* UCRL-77326
CONF-760402-		
1	1:8226	Dep. NTIS, $3.50
2	1:8132	*See* BNL-20754
4	1:8250	Dep. NTIS, $3.50
CONF-760404-		
1	1:9603	*See* SAND-75-6100
2	1:9207	*See* UCRL-77095
CONF-760405-		
1	1:8383	*See* SAND-76-5176
CONF-760406-		
1	1:9342	*See* BNL-20813
CONF-760407-		
1	1:9387	*See* UCRL-77267
2	1:9388	*See* UCRL-77273
CONF-760411-		
2	1:9264	*See* SAND-75-5790
CONF-760501-		
1	1:9206	*See* UCRL-76804
COO-		
690-47	1:9514	Dep. NTIS, $5.50
1106-1	1:9581	Dep. NTIS, $3.50
1140-217	1:9024	Dep. NTIS, $3.50
1167-36	1:9716	Dep. NTIS, $3.50
1231-104	1:9463	Dep. NTIS, $4.00
1617-45	1:9181	Dep. NTIS, $4.00
1676-38	1:8947	Dep. NTIS, $3.50
1771-6	1:9411	Dep. NTIS, $5.50
2001-12	1:9532	Dep. NTIS, $3.50
2186-29	1:9844	Dep. NTIS, $4.50
2218-60P	1:10052	Dep. NTIS, $3.50
2245-23	1:8548	AT
2263-4	1:8885	Dep. NTIS, $6.75
2294-2	1:8691	NRC
2383-0026	1:10189	Dep. NTIS, $3.50
2422-04	1:8948	Dep. NTIS, $3.50
2482-2(Rev.)	1:10190	Dep. NTIS, $4.00
2547-4	1:8777	Dep. NTIS, $6.00
2569—1	1:8336	Dep. NTIS, $4.00
2673-1	1:8481	Dep. NTIS, $4.00
2679-3	1:8927	Dep. NTIS, $4.00
2696-001	1:9876	Dep. NTIS, $3.50
2699-1	1:8382	Dep. NTIS, $6.00
2733-2	1:8949	Dep. NTIS, $4.00
3021-10	1:8617	Dep. NTIS, $3.50
3077-80	1:9260	New York; Springer-Verlag New York Inc. (1975).
3077-97	1:10191	Dep. NTIS, $4.50
3077-99	1:10192	Dep. NTIS, $5.50
3083-11	1:9429	Dep. NTIS, $3.50
3142-5	1:9148	Dep. NTIS, $3.50
3368-6	1:10179	Dep. NTIS, $6.00
3470-4	1:9717	Dep. NTIS, $3.50
3521-166	1:9470	*See* TID-26975
3521-167	1:9470	*See* TID-26975
3521-168	1:9470	*See* TID-26975
CPC-		
1(Rev.3)(Vol.1)	1:8586	Consumers Power Co., Jackson, MI
CRBRP-PMC-		
75-04	1:8549	AT
CREARE-TN-		
217	1:8692	Dep. NTIS, $6.00
CRN-CNPA-		
75-2	1:9347	INIS
75-11	1:9348	Dep. NTIS (US Sales Only), $4.50
CRSSA-		
1973	1:9488	INIS
DESY-SR-		
75/03	1:9111	INIS
DOCKET-50201-		
171	1:8313	
172	1:8314	Dep. NTIS, $5.00
173	1:8315	Dep. NTIS, $3.50
DOCKET-50332-		
55	1:8316	Dep. NTIS, $5.00
DOCKET-701308-		
4	1:8317	Dep. NTIS, $5.00
5	1:8318	Dep. NTIS, $5.50
DOT-TSC-OST-		
74-43	1:8874	*See* PB-246129
75-23	1:8771	*See* PB-244609
DP-		
1398	1:9421	Dep. NTIS, $4.50
DPST-		
75-218	1:8333	Dep. NTIS, $3.50
E-		
8133	1:8434	*See* N-75-17712
8172	1:8433	*See* N-75-13380
EDFB-IBP-		
74-2	1:9409	Dep. NTIS, $7.00
ENDF-		
216	1:9835	*See* BNL-NCS-50446
217	1:9906	*See* BNL-NCS-50451
EPA-		
520/3-75-019	1:8658	
600/5-74-009	1:9377	GPO, $2.25
600/5-74-030	1:9423	GPO, $4.15
EPRI-		
7825-FR	1:8488	Dep. NTIS, $8.00
7825-TR	1:8489	Dep. NTIS, $5.50
EPRI-SR-		
3	1:8559	*See* PB-239513
5	1:8297	*See* PB-239515
ERDA-		
76-22	1:9553	Dep. NTIS, $7.60
76-35	1:8203	Dep. NTIS, $5.50
87-1	1:8757	Dep. NTIS, $4.00
87-2	1:10180	Dep. NTIS, $5.45
98	1:10181	Dep. NTIS, $10.60
106	1:10116	Dep. NTIS, $4.00
107(Vol.1)	1:8778	Dep. NTIS, $5.45
107(Vol.2)	1:8779	Dep. NTIS, $7.60
110(Vol.5)	1:9373	Dep. NTIS, $10.60
112-75/1	1:8133	Dep. NTIS, $3.50
114-75/1	1:8137	Dep. NTIS, $4.00
115	1:10082	Dep. NTIS, $4.00
1535(Vol.1)	1:8655	Dep. NTIS, $12.50
1535(Vol.2)	1:8656	Dep. NTIS, $16.25
1535(Vol.3)	1:8657	Dep. NTIS, $21.25
1538(Vol.1)	1:8325	Dep. NTIS, $13.60 (Vols. 1 and 2)
1538(Vol.2)	1:8326	Dep. NTIS, $13.60 (Vols. 1 and 2)
1546(DRAFT)	1:9298	W.H. Pennington, Environmental and Safety, Washington, DC
1547(Draft)	1:8116	USERDA, Washington, DC
ERDA/JPL-		
954144-75/1	1:8374	Dep. NTIS, $5.00
954144-75/2	1:8375	Dep. NTIS, $5.00
954338-75/1	1:8376	Dep. NTIS, $4.00
954339-75/1	1:8377	Dep. NTIS, $4.00
ERDA-tr-		
66	1:10075	Dep. NTIS, $5.45
84	1:9058	Dep. NTIS, $4.50
86	1:8970	Dep. NTIS, $6.00
90	1:8296	Dep. NTIS, $4.50
92	1:9210	Dep. NTIS, $3.50
96	1:9361	Dep. NTIS, $7.75
97	1:10105	Dep. NTIS, $3.50
98	1:10104	Dep. NTIS, $3.50
102-P2	1:8878	Dep. NTIS, $7.60
102-P3	1:8879	Dep. NTIS, $7.60
103	1:8484	Dep. NTIS, $3.50
104	1:8480	Dep. NTIS, $4.00
105	1:9356	Dep. NTIS, $3.50

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106	1:10103	Dep. NTIS, $3.50
108	1:8220	Dep. NTIS, $3.50
113	1:9473	Dep. NTIS, $3.50
ETR-		
1002	1:8694	Ebasco Services, Inc., New York, NY
FE-		
1220-04	1:8119	Dep. NTIS, $3.50
1224-49	1:8209	Dep. NTIS, $4.00
1513-3	1:8138	Dep. NTIS, $3.50
1760-2	1:8877	Dep. NTIS, $5.45
1773-11	1:8362	Dep. NTIS, $6.00
1780-2	1:8249	*See* ANL/ES-CEN-1013
2006-1	1:8139	Dep. NTIS, $4.50
2029-2	1:8140	Dep. NTIS, $4.00
2035-1	1:8227	Dep. NTIS, $3.50
2083-1	1:8203	*See* ERDA-76-35
2201-2	1:8251	Dep. NTIS, $3.50
FEA-		
76-3	1:8833	*See* NP-20698
FEA/A-		
75/607	1:8760	Office of Communications and Public Affairs, Federal Energy Administration, Washington DC 20461
FEA/B-		
75/375	1:8759	*See* PB-246703
75/376	1:8787	NTIS
75/588	1:8789	*See* PB-246271
75/589	1:8790	*See* PB-246272
76/050	1:8826	NTIS
FEA/D-		
75/404	1:8770	*See* PB-244154
75/463	1:8854	*See* NP-20642
75/663	1:8772	*See* PB-246352
76/011	1:8768	NTIS
FEA-EATR-		
75-11	1:8820	*See* PB-246210
FEA/G-		
75/384A	1:8866	*See* PB-247126
75/384B	1:8867	*See* PB-247127
75/384C	1:8868	*See* PB-247128
75/384R	1:8865	*See* PB-246639
FRNC-TH-		
551	1:9112	INIS
583	1:10025	INIS
GA-A-		
12821-A(Amend.A)	1:8534	General Atomic Co., San Diego, CA
13100	1:8535	Dep. NTIS, $5.45
13546	1:8319	Dep. NTIS, $5.45
13565	1:8550	Dep. NTIS, $7.60
13617(Vol.2)	1:8695	Dep. NTIS, $7.60
13668	1:10135	Dep. NTIS, $3.50
13687	1:10136	Dep. NTIS, $3.50
13703	1:8696	Dep. NTIS, $5.45
13728	1:8536	Dep. NTIS, $4.00
13813	1:8506	Dep. NTIS, $3.50
GA-LTR-		
8(Amend.A)	1:8534	*See* GA-A-12821-A(Amend.A)
GEAP-		
4397	1:8646	Dep. NTIS, $4.50
10028-55	1:8551	AT
13771—16	1:8552	AT
14032-3	1:8553	AT
14038-3	1:8697	AT
GERHTR-		
139	1:8322	Dep. NTIS, $6.00
GJO-		
1640	1:8300	Dep. NTIS, $10.75
1656	1:9303	Dep. NTIS, $4.50
GS-B-		
1411	1:8828	GPO, Stock No. 024-001-02694-5
HASL-		
299	1:9541	Dep. NTIS, $3.50
HEDL-SA-		
765	1:9015	Dep. NTIS, $3.50
HEDL-TME-		
74-3(Vol.2)	1:8662	AT
74-58	1:8663	Dep. NTIS, $6.50
75-86	1:8664	Dep. NTIS, $4.25
75-136	1:8320	Dep. NTIS, $5.50
HHR-		
1	1:8636	H.H. Robertson Co., Ambridge, PA
HMI-B-		
182	1:9275	Dep. NTIS (US Sales Only), $4.00
HUD-PDR-EIS-		
75-1F	1:8780	NTIS
ICP-		
1081	1:8321	Dep. NTIS, $4.00
IEA-		
75-3	1:8596	Dep. NTIS, $6.00
IFA-DT-		
1-1975	1:10193	Dep. NTIS (US Sales Only), $4.00
IFTJ-		
69/E	1:9349	Dep. NTIS (US Sales Only), $3.50
73/I	1:9408	Dep. NTIS (US Sales Only), $4.50
INDC(US)-		
69/L	1:9906	*See* BNL-NCS-50451
70/L	1:9835	*See* BNL-NCS-50446
IS-		
3623	1:8916	Dep. NTIS, $4.00
3800	1:10194	Dep. NTIS, $4.00
IS-ICP-		
14	1:8241	Dep. NTIS, $4.00
14	1:8825	EMRRI Document Library, Room 201 Spedding Hall, Iowa State University, Ames, IA 50011
IS-M-		
51	1:10026	Dep. NTIS, $4.50
57	1:9413	Dep. NTIS, $4.00
58	1:10195	Dep. NTIS, $3.50
IS-T-		
699	1:9149	Dep. NTIS, $9.25
ISS-R-		
74/14	1:9090	Dep. NTIS (US Sales Only), $4.50
ITP-		
75-28R	1:10003	Dep. NTIS (US Sales Only), $4.00
75-40R	1:10004	Dep. NTIS (US Sales Only), $3.50
75-59R	1:10005	Dep. NTIS (US Sales Only), $3.50
75-62R	1:9570	Dep. NTIS (US Sales Only), $3.50
75-66R	1:10006	Dep. NTIS (US Sales Only), $4.00
75-69R	1:9582	Dep. NTIS (US Sales Only), $3.50
75-71R	1:10007	Dep. NTIS (US Sales Only), $3.50
JINR-		
P11-9108	1:9283	Dep. NTIS (US Sales Only), $4.50
P13-9221	1:9193	Dep. NTIS (US Sales Only), $4.50
JPRS-		
66866	1:8242	NTIS
JUL-		
902-DV	1:10196	Dep. NTIS (US Sales Only), $5.00
1178	1:8893	*See* KFK-2200
1233	1:9042	Dep. NTIS (US Sales Only), $5.50
1238	1:8537	Dep. NTIS (US Sales Only), $5.50
1241	1:8538	Dep. NTIS (US Sales Only), $5.50
JUL-Conf-		
13	1:9150	
K-		
1839(Pt.5)	1:8301	Dep. NTIS, $5.00
KFK-		
1793	1:8897	Dep. NTIS (US Sales Only), $4.00
2139	1:9025	INIS
2200	1:8893	INIS
2207	1:8486	Dep. NTIS (US Sales Only), $6.75

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KFKI-		
75-61	1:8971	Dep. NTIS (US Sales Only), $4.25
KSC-		
1037-1	1:8698	Dep. NTIS, $10.60
LA-		
6037-MS	1:9043	Dep. NTIS, $4.00
6048-PR	1:8554	Dep. NTIS, $4.00
6071	1:10047	Dep. NTIS, $4.50
6080-PR	1:8410	Dep. NTIS, $4.50
6104-MS	1:8699	Dep. NTIS, $4.50
6109-PR	1:9280	Dep. NTIS, $5.45
6114	1:8555	Dep. NTIS, $4.00
6146-MS	1:8972	Dep. NTIS, $4.00
6148-MS	1:8411	Dep. NTIS, $4.50
6152-MS	1:8618	Dep. NTIS, $4.00
6155-PR	1:8556	Dep. NTIS, $4.00
6161-PR	1:8700	Dep. NTIS, $5.50
6169-MS	1:8412	Dep. NTIS, $4.50
6175-MS	1:8413	Dep. NTIS, $4.50
6187-MS	1:10197	Dep. NTIS, $4.50
6199-MS	1:8400	Dep. NTIS, $4.50
6224-MS	1:8701	Dep. NTIS, $4.50
LA-tr-		
75-33	1:9987	Dep. NTIS, $5.00
LA-UR-		
75-2085	1:8702	Dep. NTIS, $4.50
75-2212	1:8703	Dep. NTIS, $4.50
75-2242	1:9194	Dep. NTIS, $3.50
75-2308	1:9195	Dep. NTIS, $3.50
75-2312	1:9350	Dep. NTIS, $3.50
75-2313	1:8482	Dep. NTIS, $3.50
75-2335	1:8408	Dep. NTIS, $4.00
75-2375	1:8352	Dep. NTIS, $3.50
76-72	1:8353	Dep. NTIS, $3.50
76-86	1:8228	Dep. NTIS, $3.50
76-228	1:9489	Dep. NTIS, $3.50
76-459	1:9445	Dep. NTIS, $3.50
76-525	1:9446	Dep. NTIS, $4.00
LBL-		
1(Vol.2)(Add.2)	1:9414	LBL, $7.00
3124	1:8950	Dep. NTIS, $9.25
3628	1:9685	Dep. NTIS, $5.50
3858	1:9571	Dep. NTIS, $4.50
3872	1:9469	Dep. NTIS, $3.50
3989	1:9109	Dep. NTIS, $4.50
4147	1:9113	Dep. NTIS, $8.00
4179	1:10036	Dep. NTIS, $4.50
4210	1:9295	Dep. NTIS, $3.50
4273	1:8917	Dep. NTIS, $3.50
4417	1:9430	Dep. NTIS, $3.50
4422	1:8402	Dep. NTIS, $3.50
4537	1:9164	Dep. NTIS, $4.00
4553	1:8378	Dep. NTIS, $4.00
4563	1:8973	Dep. NTIS, $3.50
4604	1:10198	Dep. NTIS, $4.00
4648	1:10199	Dep. NTIS, $3.50
LF-tr-		
98	1:9501	Dep. NTIS, $5.00
100	1:9507	Dep. NTIS, $4.00
103	1:9539	Dep. NTIS, $3.50
105	1:9504	Dep. NTIS, $4.00
106	1:9481	Dep. NTIS, $3.50
107	1:9480	Dep. NTIS, $3.50
109	1:9499	Dep. NTIS, $3.50
110	1:9502	Dep. NTIS, $3.50
113	1:9500	Dep. NTIS, $3.50
114	1:9479	Dep. NTIS, $3.50
115	1:9487	Dep. NTIS, $3.50
116	1:9503	Dep. NTIS, $3.50
119	1:9483	Dep. NTIS, $3.50
120	1:9431	Dep. NTIS, $4.00
LMEC-		
75-10(Vol.1)	1:8665	AT
LMEC-TDR-		
75-6	1:9351	AT
MASGP-		
74-030	1:10231	*See* COM-75-10319
MATT-		
1156	1:10099	Dep. NTIS, $4.00
1168	1:10137	Dep. NTIS, $3.50
1180	1:10053	Dep. NTIS, $5.45
1192	1:10173	Dep. NTIS, $4.00
1193	1:10174	Dep. NTIS, $4.00
1197	1:10138	Dep. NTIS, $4.00
1199	1:10100	Dep. NTIS, $3.50
1200	1:10101	Dep. NTIS, $3.50
MHSMP-		
75-39	1:9196	Dep. NTIS, $4.50
75-40I	1:9363	Dep. NTIS, $3.50
75-40K	1:9364	Dep. NTIS, $3.50
75-40N	1:9365	Dep. NTIS, $3.50
75-58	1:9091	Dep. NTIS, $3.50
MITSG-		
74-27	1:8894	*See* COM-75-10359
MLM-		
2234	1:9182	Dep. NTIS, $4.00
2262	1:8328	Dep. NTIS, $4.00
2277	1:8951	Dep. NTIS, $4.00
2286	1:9095	Dep. NTIS, $4.00
2292	1:10148	Dep. NTIS, $4.00
MTR-		
6970	1:8439	*See* NSF-RA-N-75-050
N-		
75-10587	1:8429	NTIS, $4.25
75-13380	1:8433	NTIS, $3.75
75-13384	1:8467	NTIS, $4.25
75-13385	1:8430	NTIS, $4.25
75-17712	1:8434	NTIS, $3.75
75-17786	1:8435	NTIS, $3.75
NASA-TM-X-		
3198	1:8434	*See* N-75-17712
71634	1:8433	*See* N-75-13380
NASA-TT-F-		
15982	1:8429	*See* N-75-10587
16057	1:8467	*See* N-75-13384
16058	1:8430	*See* N-75-13385
16195	1:8435	*See* N-75-17786
NBS-BSS-		
79	1:8769	GPO, $1.15, SD Catalog No. C13.29:2/79
NBS-SPEC.PUBL.-		
400-13	1:9302	*See* COM-75-10342
419	1:8840	GPO, $2.80, SD Catalog No. C13.10:419
NBSIR-		
75-712	1:8843	*See* COM-75-11070
NEACRP-L-		
145	1:9835	*See* BNL-NCS-50446
147	1:9906	*See* BNL-NCS-50451
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192/L	1:9906	*See* BNL-NCS-50451
193/L	1:9835	*See* BNL-NCS-50446
NEDO-		
11209—02	1:8507	General Electric Co., San Jose, CA
21069	1:8508	General Electric Co., San Jose, CA
NLCO-		
1128	1:8918	Dep. NTIS, $4.50
NP-		
20636	1:8851	TIC
20637	1:8863	TIC
20638	1:8852	TIC
20640	1:8853	TIC
20642	1:8854	TIC
20644	1:8829	TIC
20645	1:8788	TIC
20646	1:8831	TIC
20647	1:8832	TIC
20648	1:8835	TIC
20649	1:8864	Dep. NTIS (US Sales Only), $7.60
20650	1:8855	TIC
20651	1:8850	TIC
20652	1:8794	TIC
20653	1:8818	TIC
20654	1:8873	TIC
20655	1:8856	TIC
20657	1:8795	TIC
20694	1:8848	TIC
20695	1:8762	TIC
20696	1:8796	TIC
20697	1:8797	TIC
20698	1:8833	TIC
20699	1:8798	TIC
20778	1:8289	TIC
20806	1:8801	GPO, $3.85
20826	1:8883	Dep. NTIS (US Sales Only), $5.50

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20836	1:9378	OECD Nuclear Energy Agency, Paris
20836(App.)	1:9379	Dep. NTIS (US Sales Only), $4.00
NRCI-		
75/10	1:8587	TIC, $4.00
75/11	1:8588	TIC, $3.25
NRL-Report-		
7936	1:8952	Office of Naval Research, Arlington, VA
NSF-		
85-37	1:8763	GPO, $3.80, Stock No. 038-000-00255-4
NSF-OCA-GJ-		
35568X-426	1:10201	*See* ORO-3443-57
NSF/RA/N-		
74-091	1:8436	
74-113	1:8437	
74-127	1:8416	
74-142	1:8438	
75-019	1:8845	*See* PB-243908
75/037	1:8821	*See* PB-247678
75-050	1:8439	Dep. NTIS, $17.25
NTIS/PS-		
75/112	1:8243	NTIS, $25.00
75/118	1:8282	NTIS, $25.00
75/152	1:8283	NTIS, $25.00
75/209	1:9380	NTIS, $25.00
75/210	1:9545	NTIS, $25.00
75/267	1:9381	NTIS, $25.00
75/268	1:9546	NTIS, $25.00
75/286	1:9554	NTIS, $25.00
75/510	1:8285	NTIS, $25.00
75/540	1:8255	NTIS, $25.00
75/593	1:8122	NTIS, $25.00
75/595	1:8284	NTIS, $25.00
75/649	1:8723	NTIS, $25.00
75/698	1:9415	NTIS, $25.00
75/714	1:8244	NTIS, $25.00
75/751	1:8245	NTIS, $25.00
NUREG-		
75/021	1:9394	*See* PB-240405
OOE-OS-		
003	1:9393	*See* PB-239191
ORNL-		
4865	1:8666	Dep. NTIS, $7.60
5044(Vol.3)	1:8637	Dep. NTIS, $10.60
5046	1:10178	Dep. NTIS, $10.60
5050	1:9183	Dep. NTIS, $5.45
5051	1:8303	Dep. NTIS, $5.50
5096	1:9052	AT
5110	1:8705	Dep. NTIS, $5.00
ORNL-EIS-		
83	1:9382	Dep. NTIS, $5.00
84	1:9383	Dep. NTIS, $4.00
ORNL-HUD-MIUS-		
15	1:8781	Dep. NTIS, $6.00
19	1:8782	Dep. NTIS, $5.50
ORNL-MIT-		
29	1:9197	Dep. NTIS, $4.00
62	1:8706	Dep. NTIS, $4.00
180	1:8406	Dep. NTIS, $4.50
ORNL-NSF-EATC-		
22	1:9384	Dep. NTIS, $8.75
ORNL-NSF-EP-		
86	1:8819	Dep. NTIS, $5.50
ORNL-TM-		
4446	1:8668	AT
4786	1:9321	Dep. NTIS, $5.00
4828	1:8652	AT
4936	1:8557	AT
4993	1:8953	AT
5003(Suppl.1)	1:8558	AT
5076	1:8707	AT
5080	1:10150	Dep. NTIS, $5.50
5132	1:8539	Dep. NTIS, $5.00
5136	1:8540	Dep. NTIS, $5.00
5145	1:8708	Dep. NTIS, $8.75
5146	1:8892	Dep. NTIS, $6.00
5162	1:9327	Dep. NTIS, $5.00
5170	1:8954	Dep. NTIS, $6.50
5176	1:9993	AT
5178	1:8709	Dep. NTIS, $4.00
5188	1:9980	Dep. NTIS, $7.00
5194	1:8919	Dep. NTIS, $4.50
5216	1:8669	Dep. NTIS, $5.00
5222	1:9304	Dep. NTIS, $5.00
5238	1:8710	Dep. NTIS, $4.50
5246	1:8117	Dep. NTIS, $5.00
5269	1:8670	Dep. NTIS, $4.00
5337	1:9528	Dep. NTIS, $4.00
ORNL-tr-		
2995	1:8295	Dep. NTIS, $4.00
4004	1:8577	Dep. NTIS, $4.25
4050	1:9116	Dep. NTIS, $3.50
4054	1:9401	Dep. NTIS, $5.50
4057	1:9400	Dep. NTIS, $4.50
4059	1:9605	Dep. NTIS, $4.25
4062	1:9029	Dep. NTIS, $3.50
4070	1:9285	Dep. NTIS, $3.50
4071	1:9284	Dep. NTIS, $3.50
4073	1:9028	Dep. NTIS, $4.25
4084	1:9115	Dep. NTIS, $3.50
4099	1:9505	Dep. NTIS, $3.50
4104	1:9556	Dep. NTIS, $3.50
4105	1:9550	Dep. NTIS, $3.50
ORO-		
1316-198	1:9864	Dep. NTIS, $4.00
3346-173	1:9868	Dep. NTIS, $5.00
3443-56	1:10200	Dep. NTIS, $4.00
3443-57	1:10201	Dep. NTIS, $4.00
3792-17	1:9490	Dep. NTIS, $3.50
3992-242	1:9666	Dep. NTIS, $3.50
4311-4	1:8928	Dep. NTIS, $3.50
4856-26	1:9922	Dep. NTIS, $13.60
4908-1	1:8385	Dep. NTIS, $3.50
PATENTS-US-		
A518,544	1:8390	
A518,684	1:8391	
A531,576	1:8392	
3,820,965	1:8364	
3,839,190	1:8267	
3,867,416	1:8366	
3,871,917	1:8727	
3,871,918	1:8743	
3,871,919	1:8744	
3,871,921	1:8728	
3,871,922	1:8889	
3,871,923	1:8726	
3,873,283	1:8268	
3,874,934	1:8729	
3,881,957	1:8887	
3,882,941	1:8290	
3,883,318	1:8269	
3,884,724	1:8730	
3,885,627	1:8260	
3,886,495	1:8256	
3,888,308	1:8263	
3,888,311	1:8261	
3,888,312	1:8262	
3,893,906	1:8276	
3,893,908	1:8270	
3,893,912	1:8275	
3,893,913	1:8274	
3,895,283	1:8745	
3,896,024	1:8271	
3,896,876	1:8281	
3,899,357	1:8747	
3,899,358	1:8746	
3,902,555	1:8264	
3,902,557	1:8265	
3,902,869	1:8278	
3,902,870	1:8277	
3,904,384	1:8279	
3,904,432	1:8748	
3,907,588	1:8750	
3,907,594	1:8749	
3,907,603	1:8731	
3,907,981	1:9134	
3,908,763	1:8266	
3,909,208	1:8272	
3,909,212	1:8124	
3,909,213	1:8126	
3,909,390	1:8215	
3,909,396	1:8125	
3,909,446	1:8351	
3,910,235	1:8252	
3,910,428	1:8216	
3,910,768	1:8273	
3,910,775	1:8372	

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3,910,777	1:8127	
3,910,800	1:8751	
3,911,093	1:8230	
3,911,288	1:8493	
3,912,015	1:8247	
3,912,463	1:8280	
3,912,465	1:8121	
3,912,544	1:8732	
3,914,390	1:8231	
3,914,794	1:8523	
3,914,795	1:8524	
3,915,122	1:8526	
3,915,462	1:8639	
3,915,670	1:8367	
3,915,741	1:8734	
3,915,744	1:8735	
3,915,745	1:8736	
3,915,751	1:8733	
3,915,793	1:8510	
3,916,025	1:8232	
3,916,338	1:9246	
3,916,444	1:8527	
3,916,445	1:8525	
3,916,841	1:8528	
3,916,944	1:8529	
3,917,335	1:8647	
3,917,465	1:8129	
3,917,467	1:8369	
3,917,468	1:8368	
3,917,469	1:8233	
3,917,569	1:8128	
3,917,768	1:8648	
3,917,795	1:8238	
3,917,797	1:8234	
3,917,798	1:8237	
3,917,799	1:8236	
3,917,800	1:8235	
3,918,272	1:8640	
3,918,689	1:8641	
3,918,761	1:8130	
3,918,834	1:8287	
3,918,990	1:8752	
3,918,991	1:8737	
3,919,043	1:8654	
3,919,390	1:8131	
3,919,393	1:8239	
3,919,394	1:8240	
3,919,547	1:8258	
3,919,720	1:8530	
3,919,842	1:8906	
3,919,880	1:8642	
3,919,983	1:8907	
3,919,984	1:8900	
3,919,985	1:8901	
3,919,986	1:8902	
3,919,988	1:8903	
3,919,993	1:8904	
3,919,994	1:8899	
3,919,998	1:8396	
3,920,039	1:8248	
3,920,404	1:8905	
3,920,413	1:8395	
3,920,416	1:8354	
3,920,417	1:8202	
3,920,418	1:8201	
3,920,474	1:8888	
3,920,478	1:8738	
3,920,479	1:8753	
3,920,480	1:8884	
3,920,512	1:8580	
3,920,513	1:8532	
3,920,514	1:8531	
3,920,515	1:8651	
3,920,516	1:8650	
3,920,517	1:8649	
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3,920,536	1:8217	
3,920,579	1:8356	
3,920,717	1:8371	
3,920,804	1:8355	
3,920,998	1:9322	
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3,921,049	1:8379	
3,921,395	1:8909	
3,921,396	1:8908	
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3,922,148	1:8370	
3,922,150	1:8643	
3,922,175	1:8740	
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3,922,192	1:8581	
3,922,215	1:8293	
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238189	1:8844	NTIS, $3.75
238595	1:8465	NTIS, $5.25
238655	1:8294	NTIS, $8.75
239191	1:9393	NTIS, $4.25
239272	1:8428	NTIS, $5.75
239408	1:8479	NTIS, $7.50
239513	1:8559	NTIS, $3.75
239515	1:8297	NTIS, $5.25
239675	1:8597	NTIS, $7.25
239718	1:8414	NTIS, $5.75
239773	1:8810	NTIS, $3.75
240008	1:8811	NTIS, $8.75
240113	1:8363	NTIS, $4.25
240285	1:9422	NTIS, $4.75
240300	1:8895	NTIS, $4.75
240405	1:9394	NTIS, $4.75
241462	1:8386	NTIS, $3.75
242071	1:8758	NTIS, $5.25
243908	1:8845	NTIS, $12.00
243920	1:8857	NTIS, $5.25
244154	1:8770	NTIS, $8.75
244609	1:8771	NTIS, $5.25
245021	1:8799	NTIS, $8.50
246129	1:8874	NTIS, $4.50
246210	1:8820	NTIS, $3.50
246271	1:8789	NTIS, $8.50
246272	1:8790	NTIS, $8.75
246352	1:8772	NTIS, $3.50
246639	1:8865	NTIS, $4.00
246703	1:8759	NTIS
247126	1:8866	NTIS, $9.00
247127	1:8867	NTIS, $4.50
247128	1:8868	NTIS, $5.00
247678	1:8821	NTIS, $8.00
249544	1:8812	NTIS, $4.50
PD-		
18972	1:8725	*See* ADB-008547
PEM-		
30	1:9337	Dep. NTIS, $4.50
33	1:9338	Dep. NTIS, $4.50
34	1:9339	Dep. NTIS, $5.00
38	1:9340	Dep. NTIS, $4.50
PGE-		
8003(Rev.0)	1:8509	
PRNC-		
192(Vol.1)	1:9374	Dep. NTIS, $6.75
PTB-ATWD-		
6	1:10229	Dep. NTIS (US Sales Only), $4.00
RDT-C-		
10-3T(Rev.)(12-75)	1:9315	RSO
15-11T(12-75)	1:9305	RSO
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7-2T(Amend.1)(1-5-76)	1:9238	RSO
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1-76(Suppl.)	1:8590	RSO
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1.35(Rev.2)	1:8592	NUREG
10.1(1-75)	1:8593	NUREG
RFP-Trans-		
172	1:9079	Dep. NTIS, $4.50
175	1:9117	Dep. NTIS, $4.25
179	1:9155	Dep. NTIS, $3.50
180	1:8975	Dep. NTIS, $3.50
RISO-M-		
1813	1:9385	Dep. NTIS (US Sales Only), $4.00
RRL-		
3238-541(Q-73)	1:9169	Dep. NTIS, $3.50
3238-542	1:9170	Dep. NTIS, $4.00

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RT/ING-		
(75)11	1:8560	Dep. NTIS (US Sales Only), $3.50
SAND-		
74-0087	1:9198	Dep. NTIS, $4.50
74-0088	1:9199	Dep. NTIS, $5.00
74-8682	1:10151	Dep. NTIS, $4.00
75-0304	1:9276	Dep. NTIS, $3.50
75-0331	1:9563	Dep. NTIS, $4.00
75-0338	1:9044	Dep. NTIS, $4.00
75-0485(Rev.)	1:9277	Dep. NTIS, $4.50
75-0491	1:9200	Dep. NTIS, $4.50
75-0516	1:9366	Dep. NTIS, $4.50
75-0530	1:8466	Dep. NTIS, $5.00
75-0580	1:8349	Dep. NTIS, $4.00
75-0608	1:8401	Dep. NTIS, $4.50
75-0611	1:9523	Dep. NTIS, $5.00
75-0632	1:8711	Dep. NTIS, $4.50
75-0667	1:8490	Dep. NTIS, $4.50
75-5604	1:9097	Dep. NTIS, $3.50
75-5766	1:10175	Dep. NTIS, $4.00
75-5779	1:8974	Dep. NTIS, $4.50
75-5790	1:9264	Dep. NTIS, $3.50
75-5798	1:9239	Dep. NTIS, $5.00
75-5848	1:9114	Dep. NTIS, $4.00
75-5875	1:9086	Dep. NTIS, $4.00
75-6009	1:8965	Dep. NTIS, $6.75
75-6068	1:8334	Dep. NTIS, $4.50
75-6076	1:10202	Dep. NTIS, $3.50
75-6100	1:9603	Dep. NTIS, $3.50
75-6167	1:8483	Dep. NTIS, $3.50
75-7072	1:9189	Dep. NTIS, $7.50
75-7087	1:9151	Dep. NTIS, $3.50
75-7088	1:9201	Dep. NTIS, $5.50
75-8044	1:9202	Dep. NTIS, $5.50
75-8059	1:9203	Dep. NTIS, $9.25
75-8222	1:9082	Dep. NTIS, $3.50
75-8301	1:8955	Dep. NTIS, $4.50
75-8695	1:8361	Dep. NTIS, $3.50
75-8697	1:8896	Dep. NTIS, $3.50
76-5039	1:9237	Dep. NTIS, $3.50
76-5176	1:8383	Dep. NTIS, $3.50
76-6011	1:9208	Dep. NTIS, $5.00
76-6013	1:9209	Dep. NTIS, $4.50
76-6014	1:9368	Dep. NTIS, $4.00
SC-RR-		
71-0658	1:9248	Dep. NTIS, $14.25
SES-PUB-SEG-		
74-126	1:10203	Dep. NTIS (US Sales Only), $5.00
SGAE-		
2456	1:9547	Dep. NTIS (US Sales Only), $3.50
SGP-TR-		
1	1:8414	*See* PB-239718
SLAC-		
188	1:9672	Dep. NTIS, $5.50
SRL-		
76003	1:9538	Dep. NTIS, $3.50
SRO-		
640-7	1:9171	Dep. NTIS, $3.50
STAN-CS-		
75-533	1:10198	*See* LBL-4604
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10/170	1:9512	IAEA, $9.00
STI/PUB-		
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TEC-		
75/004	1:8911	Dep. NTIS, $5.00
75/005	1:8912	Dep. NTIS, $5.45
TID-		
3356	1:9609	Dep. NTIS, $13.60
3357	1:8298	Dep. NTIS, $4.00
4584	1:10230	TIC
25650-S1	1:9395	Dep. NTIS, $7.60
26913	1:10083	Dep. NTIS, $9.00
26943	1:9026	Dep. NTIS, $4.50
26973	1:9416	Dep. NTIS, $3.50
26975	1:9470	Dep. NTIS, $7.00
26977	1:9265	Dep. NTIS, $4.50
26985	1:8399	Dep. NTIS, $4.00
TN-BN-		
827	1:10200	*See* ORO-3443-56
TT-		
72-52003	1:8619	*See* AEC-tr-7295
72-52018	1:10222	New Delhi, India; Amerind Publishing Co. Pvt. Ltd. (1975).
72-58020	1:9186	*See* AEC-tr-7315
74-54003/6	1:9100	*See* AEC-tr-7533/6
74-54003/10	1:9172	*See* AEC-tr-7533/10
UCCND-CSD-INF-		
56	1:10139	Dep. NTIS, $5.00
59	1:10204	Dep. NTIS, $6.00
UCID-		
3792	1:8397	Dep. NTIS, $3.50
16746	1:9281	Dep. NTIS, $3.50
16845	1:8141	Dep. NTIS, $4.00
16961	1:10205	Dep. NTIS, $5.45
16962	1:10054	Dep. NTIS, $4.00
16963	1:10044	Dep. NTIS, $5.45
16972	1:10008	Dep. NTIS, $4.00
16977	1:8913	Dep. NTIS, $4.00
16982	1:9060	Dep. NTIS, $3.50
16985	1:10154	Dep. NTIS, $3.50
16993	1:9240	Dep. NTIS, $4.00
16998	1:9204	Dep. NTIS, $3.50
17003	1:10206	Dep. NTIS, $4.00
17008	1:8398	Dep. NTIS, $3.50
17013	1:9604	Dep. NTIS, $4.00
17015	1:9370	Dep. NTIS, $4.00
30048(Rev.2)	1:10207	Dep. NTIS, $5.45
30100(Rev.1)	1:10208	Dep. NTIS, $4.50
30118	1:10209	Dep. NTIS, $4.00
30126	1:10210	Dep. NTIS, $3.50
30127(Pt.1)	1:10211	Dep. NTIS, $4.00
30127(Pt.2)	1:10212	Dep. NTIS, $4.50
UCLA-		
12-1016	1:9498	Dep. NTIS, $3.50
UCRL-		
13670	1:9352	Dep. NTIS, $3.50
50029-75	1:8764	Dep. NTIS, $4.00
50032-75	1:8142	Dep. NTIS, $4.00
50033-75	1:8721	Dep. NTIS, $3.50
50301	1:9205	Dep. NTIS, $3.50
51625-75	1:9397	Dep. NTIS, $5.50
51800	1:10102	Dep. NTIS, $3.50
51860	1:8339	Dep. NTIS, $4.00
51943	1:9375	Dep. NTIS, $10.60
51947	1:8914	Dep. NTIS, $5.45
51965	1:9152	
51969	1:9557	Dep. NTIS, $4.00
51970	1:10213	Dep. NTIS, $3.50
51977	1:8407	Dep. NTIS, $3.50
51978	1:8722	Dep. NTIS, $4.00
51985	1:10045	Dep. NTIS, $4.00
52000-75-11	1:10055	Dep. NTIS, $4.00
76742	1:9102	Dep. NTIS, $3.50
76804	1:9206	Dep. NTIS, $3.50
76894	1:9306	Dep. NTIS, $4.25
77095	1:9207	Dep. NTIS, $4.25
77110	1:10214	Dep. NTIS, $4.50
77139	1:10157	Dep. NTIS, $3.50
77202	1:9981	Dep. NTIS, $4.25
77259	1:10176	Dep. NTIS, $4.50
77267	1:9387	Dep. NTIS, $3.50
77271	1:9278	Dep. NTIS, $3.50
77273	1:9388	Dep. NTIS, $3.50
77326	1:8389	Dep. NTIS, $3.50
77440	1:8755	Dep. NTIS, $4.50
77453	1:10215	Dep. NTIS, $4.50
77466	1:9057	Dep. NTIS, $3.50
77544	1:8409	Dep. NTIS, $4.00
77555	1:10216	Dep. NTIS, $4.00
77624	1:10217	Dep. NTIS, $3.50
77637	1:8415	Dep. NTIS, $3.50
77659	1:9190	Dep. NTIS, $4.00
77709	1:9184	Dep. NTIS, $3.50
77766	1:10218	Dep. NTIS, $4.00
77844	1:9027	Dep. NTIS, $3.50
77850	1:8920	Dep. NTIS, $3.50
UCRL-Trans-		
10735	1:8976	Dep. NTIS, $4.00
10739	1:9066	Dep. NTIS, $3.50
10755	1:9030	Dep. NTIS, $3.50
10758	1:8929	Dep. NTIS, $3.50
10760	1:9118	Dep. NTIS, $3.50
10778	1:9367	Dep. NTIS, $8.00
10965	1:8302	Dep. NTIS, $3.50
10967	1:9389	Dep. NTIS, $3.50

Report No.	Abstract No.	Availibility
10975	1:8930	Dep. NTIS, $5.00
10977	1:8958	Dep. NTIS, $5.00
10980	1:10088	Dep. NTIS, $4.00
10981	1:10065	Dep. NTIS, $3.50
10982	1:8956	Dep. NTIS, $3.50
10985	1:10220	Dep. NTIS, $3.50
10987	1:8120	Dep. NTIS, $3.50
10988	1:8143	Dep. NTIS, $3.50
10989	1:8144	Dep. NTIS, $4.50
10995	1:9606	Dep. NTIS, $3.50
10997	1:8145	Dep. NTIS, $3.50
UIUC-CAC-DN-		
116	1:8800	NTIS
147	1:8875	NTIS
UIUCDCS-R-		
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USGS-		
474-214	1:9353	Dep. NTIS, $5.45
474-225	1:9418	Dep. NTIS, $4.00
474-226	1:9419	Dep. NTIS, $4.00
WARD-NA-		
3045-26	1:9007	AT
WARD-OX-		
3045-6(Vol.2)	1:8561	AT
WASH-		
1341and (Amend.1)	1:8594	Dep. NTIS, $4.50
XN-		
75-36NP	1:8712	Exxon Nuclear Co. Inc., Richland, WA
75-36NP(Suppl.1)	1:8713	Exxon Nuclear Co. Inc., Richland, WA
Y-JA-		
113	1:9417	Dep. NTIS, $3.50

Abbreviations Used in Availability Column

AT Liquid Metal Fast Breeder Reactor applied technology is available to domestic requesters within the United States from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.
Information regarding subscription purchase will be sent on request.
Foreign requesters should address inquiries to the above address.

Dep. ERDA reports so designated are maintained in the organizations listed on the inside front cover.

EM Inquiries regarding the availability of blueline prints of ERDA engineering drawings which were formerly available for sale by NTIS should be addressed to USERDA, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

GJO Available from USERDA, Grand Junction Office, P. O. Box 2567, Grand Junction, Colorado 81501.

GPO For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

LMEC Available *only to requesters within the United States* from the Liquid Metal Engineering Center, P. O. Box 1449, Canoga Park, CA 91304.

NTIS For sale by the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161. Price given is the domestic price for paper copy; foreign purchasers add $2.50 per report copy.

RSO Available *only to requesters within the United States* from the Reactor Standards Office, Oak Ridge National Laboratory, P. O. Box X, Oak Ridge, TN 37830.

TIC Available from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.